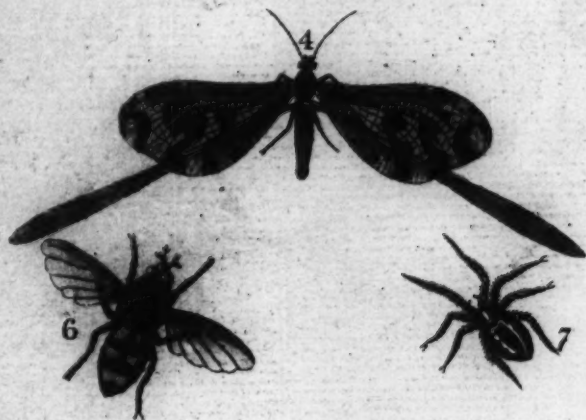


THE
NATURALIST'S
AND
TRAVELLER'S
COMPANION;

BY
JOHN COAKLEY LETTSOM. M.D.

the Third Edition.



London, C. Dilly. 1799.



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COMPANION.

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COMPANION

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PREFACE.

HE that enlarges his curiosity after the works of nature," says a celebrated writer, "demonstrably multiplies the inlets to happiness. A man that has formed a habit of turning every new object to his entertainment, finds in these productions an inexhaustible stock of materials upon which he can employ himself, without any temptations to envy or malevolence; faults, perhaps, seldom totally avoided by those, whose judgment is much exercised upon the works of art. He has always a certain prospect of discovering new reasons for adoring the sovereign Author of the universe, and probable hopes of making some discovery of benefit to others, or of profit to himself."

No method appears better calculated to enlarge our knowledge of Natural History, than visiting foreign countries, and carefully attending

attending to the different objects they afford, which more or less delight by their novelty and variety; but our inquiries should not be confined merely to private gratification; there are duties of a more rational nature; to be useful to society by distributing happiness amongst our fellow creatures, is one of the highest and most necessary. The numerous products of nature, their application to the wants, the comforts, and even ornaments of life; the manners, customs, and opinions of mankind; agriculture, manufactures, and commerce; the state of arts, learning, and the laws of different nations, when judiciously investigated, tend to enlarge the human understanding, and to render individuals wiser, better, and happier.

The introduction of the common potatoe, the management of silk-worms, the discovery of jesuits bark, the uses of cochineal, lacca and indigo, are undeniable proofs of the advantages which might be derived from the inquiries of ingenious men. The discovery of another such root as the potatoe, another such article of commerce and apparel as silk, another such remedy as the bark, and such other dying articles as cochineal and indigo, would prove acquisitions of the greatest importance to a trading

ing nation, and render the inquisitive traveller conspicuous as a public blessing.

Many gentlemen and sea-faring persons who go abroad, by their office and situation in life, enjoy both time and opportunity for collecting the best information on such subjects of general utility, especially the natural productions peculiar to the place they visit or reside in, which they are induced to overlook, for want of proper directions for distinguishing and preserving them, whereby things of value and use are lost to the public, and the time of the traveller less beneficially employed.

To promote an application of the time and talents of such persons to rational and commendable inquiries of this kind, is the design of the following directions, which the author thinks himself justified in recommending, as they principally result from experiment and observation: These were first printed in the year 1772, and the reception from the publick was such as to encourage a second edition in 1774; but this likewise being soon out of print, a third edition was not long afterwards prepared for the press, and some of the first sections were printed off several years ago;

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various avocations then intervening, prevented the completion of the remaining sections; nor would this little performance have been now resumed, had any publication appeared calculated to preclude the utility of the original plan, which has since been considerably improved, to make it more deserving of future encouragement.

In the second part are introduced several queries and observations on natural history, and upon subjects in general, which have not been clearly and sufficiently ascertained, and therefore merit the attention of the naturalist and traveller.

The principal of those writers who have appeared in different departments of Natural History, will be noticed under the particular heads they treat upon.

If persons who go abroad, or reside in foreign countries, were acquainted with mathematics and drawing, they would in all probability make their remarks more acceptable, by adding accurate maps of the countries they visit or reside in; and by joining to them the drawings of men, their dresses, utensils, weapons, coins, machines, rites, sacrifices, buildings, temples, idols, and

and antiquities ; as well as the curious quadrupeds, birds, reptiles, fish, insects, and shells peculiar to each place ; with the plants found in those climates, especially such as are employed for food, in commerce, manufactures, phylic, dying and other purposes.

In the drawings and descriptions relative to natural history, it is necessary to attend to many circumstances which are the characteristics of each species of the animal and vegetable creation. In quadrupeds the number and disposition of the teeth ; shape and position of the horns ; number of the toes in each foot ; shape and size of the claws and hoofs ; size of the ears ; colour and disposition of the whiskers ; nature and growth of the hair in the fur, mane, and tail ; length and uses of the tail ; whether calculated to grasp any object, or to give the animal stability ; and even the attitude which is characteristic of the animal, and shews best it's marks, spots, stripes, claws, ears, tail, &c. ought to be expressed.

In birds, the shape and uses of the bill, whether notched, serrated, or otherwise remarkable ; number and disposition of the toes, and whether distinct, lobated, or pal-

mated ; length of the legs and nakedness of the knees ; colour of the greater and smaller quill feathers, upper and under coverts of the wings ; number and colour of the tail feathers, and coverts of the tail ; appearance of the vent, belly, breast, throat, back, crest, wattles, caruncular, spurs, &c. ; attitude peculiar to the bird, and the difference between males and females, and young and old birds, should be described.

In tortoises and turtles the disposition of the shell, and it's compartments ; shape and number of it's toes ; absence or presence of the tail, and shape of the head, must be delineated.

In snakes, the scales above and below, their number, colour, and figure ; form of their heads, and whether they are venomous or not, should be remarked.

In fish, it is necessary to attend to the proportion of the breadth to the length ; form of the head and disposition of the palate and teeth ; shape and position of the mouth ; size and situation of the eyes ; coverts of the gill, and rays of it's underpart ; spines, horns, and protuberances of the head ; number, figure, size, and colour of

of the fins and tail, with the spinose and soft rays in each; the turn of the lateral line, with the form, colour and disposition of the scales.

In insects, the season when each of the different kinds appear should be observed; the number, substance, and particular shape of their wings, with the position of them when the insect is at rest; the shape of the antennæ or horns, with the number of joints in each; the form of the head, mouth and eyes, more particularly of the head in beetles, of the mouth in bees, wasps, flies, and gnats, and of the eyes in spiders; the number and size of the legs; the shape of the thighs, feet and claws; the stings peculiar to the hymenoptera class, and the uses they are applied to: but the natural history of insects should in a peculiar manner engage the traveller's attention, as it is of more consequence to discover the natural history of one destructive or useful insect, than merely to collect and bring over twenty in their perfect state; the former, at the same time that it makes the science more entertaining, bids fair to benefit mankind, while the latter serves only to fill the cabinets of the curious; he should therefore carefully observe the manner in which insects

sects copulate, and the places where they deposit their eggs; what food the young larvæ or caterpillars feed upon; if vegetable, whether it be the root, trunk, leaf, flower or fruit; if destructive, as they mostly are, the methods used by the natives to destroy them; and if useful, the means of cultivating them; and what are their natural enemies; the form, attitude, and markings of the caterpillar should be described; if it has feet, their number, and the particular rings on which they are situated; whether it be smooth, hairy or spinous, and the manner of it's changing into the chrysalis or pupa state, and how long it continues before it arrives to perfection, with the various instincts and contrivances they have for avoiding dangers and catching their prey.

In shells, not to neglect the number of them belonging to one animal; when single, the turn in the windings, whether to the right or left; the stripes, spots, bands, knobs, spines, furrows and other marks; shape of the mouth or opening of the shell, lips and beaks: In those that have two or more valves, their equal or different sizes; the form of the hinges where they are connected, and the number of indentures tallying together; the stripes and furrows on
the

the outsides, and whether longitudinal or transversal; and the animals inhabiting the shells should likewise be observed and delineated.

In the rest of the worm tribe, the shape, arms, and other parts of the animal should be delineated.

In plants the greatest accuracy is requisite, the shape of the flower being so varied, nice attention is necessary to distinguish it's minute parts; the figure and number of the flower leaves; the form and sections of the flower-cup; the number and disposition of the dust vessels, and of the columnar vessels standing on the fructification (which are reckoned by botanists to be the male and female parts of the flower, and in some instances are on different plants; in others on the same plant, but in different parts of it); the shape, structure, and colour of the stalk and leaves; the appearance and structure of the roots, and such other circumstances as characterize the different species of plants, ought never to be omitted.

The following method of preserving seeds, by John Sneyd, esq. should have been inserted, under the directions for bringing
over

seeds, &c. § III. p. 23, which I have extracted from the Transactions of the Society for the Encouragement of Arts, Vol. xvi. p. 265. It is merely packing up seeds in absorbent paper, and surrounding the same by raisins, or brown moist sugar; which, by experiment, seems to afford that genial moisture requisite to preserve the seeds in a state fit for vegetation.

The Naturalist should endeavour to keep an accurate journal, wherein all the occurrences, observations, places, distances, descriptions, accounts, informations, and remarks, should regularly and daily be entered, while recent in memory.

It would be advisable to write on a label fixed to each object, a number corresponding to the notes in the journal; by which means, at any future period, the object itself may be clearly ascertained.

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THE
NATURALIST's and TRAVELLER's
COMPANION, &c.

PART the FIRST.

SECT. I.

*The Method of catching and preserving
Insects for Collections.*

———— Ten thousand different tribes
People the blaze. To sunny waters some
By fatal instinct fly.

———— Through the green-wood glade
Some love to stray; there lodg'd, amus'd and fed,
In the fresh leaf. Luxurious, others make
The meads their choice, and visit every flower,
And every latent herb. (a)

INSECTS in general are known to most people, the systematic distinctions but to few; nor have we any English names for the greatest part of them. The general denomination of beetles, butterflies, moths, flies, bees, wasps,

(a) Thomson's Seasons, Summer, l. 246.

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and

and a few other common names, are all that our language supplies. It would, therefore, be in vain to enumerate the immense variety of genera and species to any person unskilled in the science of entomology: we may, however, give directions under general names, where to find and how to catch each kind. (*b*)

I. The Coleoptera (*c*), or first great class of insects, including beetles, are found in and under the dung (*d*) of animals, especially of cows, horses, and sheep: many of them make holes under the dung three or four inches deep; it will therefore be necessary to have an iron spade to dig them out, when in search of this tribe of insects.

Some (*e*) are found in rotten and half decayed wood, and under the decayed bark of trees; on the carcases (*f*) of animals that have been dead four or five days; on moist bones that have been gnawed by dogs or other animals; on flowers having a fœtid smell; and on several kinds of fungous substances, particularly the

(*b*) Vide Schoeffer. Elementa Entomologica. Curtis's accurate instructions for collecting and preserving insects, and his introduction to the knowledge of insects translated from the Fundamenta Entomologiæ of Linnæus. Amæn. Acad. v. 7.

(*c*) Coleoptera, from *κολεος*, a sheath, and *πτερον*, a wing, are such insects as have crustaceous Elytra, or shells, which shut together, and, form a longitudinal suture down to the back of the insect, as the beetle, *Buprestis ignita*, fig. 1.

(*d*) Scarabæus, *chafer*. *Dermestes*, *leather-eater*. *Hister*, *mimick-beetle*. *Staphylinus*, *rove-beetle*. (*e*) *Lucanus*, *stag-beetle*. *Cerambyx*, *capricorn-beetle*. (*f*) *Hister*. *Silpha*, *carion-beetle*.

(*g*) *Byrrhus*,

the rotten and most stinking: others (*g*) may be found in a morning about the bottoms of perpendicular rocks and sand banks, and also upon the flowers of trees and herbaceous plants.

Many kinds (*h*) may be caught in rivers, lakes, and standing pools, by means of a thread net, with small meshes, on a round wire hoop, fixed at the end of a long pole.

In the middle of the day, when the sun shines hot, (*i*) some are to be seen on plants and flowers, blighted trees and shrubs; others (*k*) in moist meadows are best discovered at night, by the shining light which they emit.

A great variety (*l*) fit close on the leaves of plants, particularly of the burdock, elecampane, coltsfoot, dock, thistle, and the like; or feed on different kinds of tender herbs (*m*).

Numbers (*n*) may be found in houses, dark cellars, damp pits, caves, and subterraneous passages, or on umbelliferous flowers (*o*), on the trunks as well as the leaves of trees; in timber-yards, and in the holes of decayed wood.

Some (*p*) inhabit wild commons, the margins of pools, marshes, and rivulets; and are likewise seen creeping on flags, reeds, and all kinds of water-plants.

Multitudēs (*q*) live under stones, moss, rubbish, and wrecks near the shores of lakes and

(*g*) *Byrrhus*, *curculio*, *weevil*. *Bruchus*, *seed-beetle*. (*h*) *Gyrinus*, *whirl-beetle*. *Dytiscus*, *water-beetle*. (*i*) *Coccinella*, *lady-fly*. *Buprestis*, *burn-cow*. *Chrysomela*, *golden honey-beetle*. *Cantharis*, *soft-winged beetle*. *Elater*, *spring-beetle*. *Necydalis*, *clipi-winged beetle*. (*k*) *Lampyrus*, *glow-worm*. (*l*) *Cassidæ*, *tortoise-beetle*. (*m*) *Meloe*, *blister-beetle*. (*n*) *Tenebrio*, *stinking-beetle*. (*o*) *Cerambyx*, *Pinus*. (*p*) *Leptura*, *wood-beetle*. *Cicindela*, *glossy beetle*. (*q*) *Carabus*, *ground-beetle*.

rivers.

rivers. These are found also in bogs, marshes, moist places, pits, and holes of the earth, on stems of trees; and in an evening they crawl plentifully along path-ways after a shower of rain.

Some (*r*) may be discovered in the hollow stems of decayed umbelliferous plants, and on many sorts of flowers and fruits.

II. Another class (*s*) of insects are found about (*t*) bake-houses, corn-mills, in ships, and in all places where meal is kept; on grass (*u*), and all kinds of field herbage. Some (*v*) of these frequent rivers, lakes and standing pools.

III. Butterflies and moths make another great division (*w*). In the day, when the sun is warm, butterflies (*x*) are seen on many sorts of trees, shrubs, plants, and flowers. Moths (*y*) may be seen in the day-time, sitting on walls, pales, trunks of trees, in shades, out-houses, dry holes, and crevices *; on fine evenings they fly about the

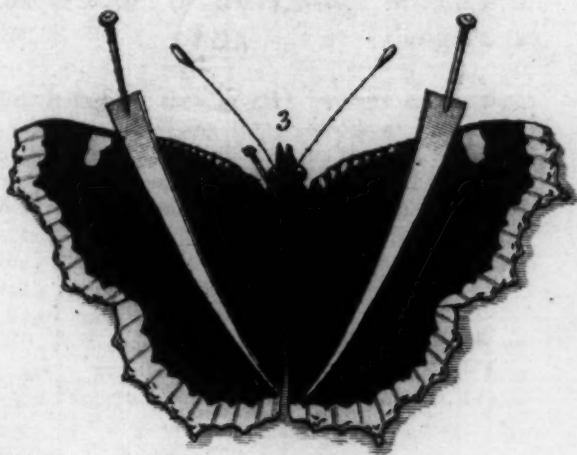
(*r*) Forficula, *earwig*.

(*s*) Hemiptera, from *ημισ*, half, and *πτερον*, a wing, have their upper wings usually half crustaceous, and half membranaceous, not divided by a longitudinal suture, but incumbent on each other, as the *Cimex*, fig. 2. (*t*) *Blatta*, *cockroach*.

(*u*) Mantis, *camel cricket*. *Gryllus*, *locust*. *Fulgora*, *cicada*, *flea-locust*. *Cimex*, *bug*. (*v*) *Notonecta*, *boat-fly*. *Nepa*, *water-scorpion*.

(*w*) *Lepidoptera*, from *λεπιδ*, a scale, and *πτερον*, a wing, are insects having four wings, covered with fine scales in the form of powder or meal, as in the butterfly, *Papilio Antiopa*, fig. 3. (*x*) *Papilio*, *butterfly*. (*y*) *Phalæna*, *moth*.

* The best method to kill moths, when standing, or sitting on walls



Darton & Co. Scn.



the places they inhabit in the day time. Some (z) are seen flying in the day-time over the flowers of honey-suckles and other plants with tubular flowers. Insects of this species seldom sit to feed, but continue vibrating on the wing, while they thrust the tongue or proboscis into the flowers.

IV. Insects of this class (a) are found in woods (b), hedges, meadows, sand-banks, walls, pales, fruits, and unbelliferous flowers; some (c) fly about lakes and rivers in the day.

V. The fifth division (d) including wasps (e), bees, (f), &c. may be seen about hedges (g), shrubs, flowers, and fruits. Wasps and bees are the only winged insects that have any great degree of poison in them; they should therefore be taken with a pair of forceps, and handled cautiously on account of their stings, which are dangerous

walls, pales, &c. is to give them a gentle pressure on the thorax, or breast, with the end of any thing smooth, as a tobacco-stopper, or tooth-pick case: this will deprive them of sense and motion for the present moment, and they will fall down on whatever is held under them; a pin should then be struck through the thorax, which should be pressed between the thumb and finger of the left-hand, till it is felt to give way a little; they may then be stuck in the receiving box.

(z) Spinx, hawk-moth.

(a) Neuroptera, from νευρον, a nerve, and πλεγον, a wing, have four membranaceous transparent naked wings, generally like network, as in the Panorpa Coa, fig. 4. (b) Myrmeleon, hemerobius, pearl-fly. Raphidia, camel-fly. (c) Libellula, dragon-fly, Ephemera, may-fly. Phryganea, spring-fly.

(d) Hymenoptera, from υμενη, a membrane, and πλεγον, a wing. Insects with four membranaceous wings, tail furnished with a sting; as in the Tenthredo, fig. 5. (e) Vespa, wasp. (f) Apis, bee. (g) Tenthredo, saw-fly. Sirex, tailed wasp. Ichneumon,

dangerous. Some (*h*) of this division have stings, but no poison, and are to be found on the flowers of umbelliferous plants, when the sun shines hot in the middle of the day; at which time others (*i*) are seen on sand-banks, walls, and pales.

VI. Flies of various kinds constitute the next class (*k*); they fly about the tops of (*l*) trees, little hills, horses, cows, sheep, ditches, dung-hills, and every offensive object. Some (*m*) are found on all sorts of flowers, particularly those of a foetid smell. Many (*n*) of these are most easily taken when they begin to feed; for in the middle of the day they are so quick and active, that it is almost impossible to catch them.

VII. The last great division (*o*) contains scorpions, spiders, crabs, lobsters, &c. It is necessary only to observe here, that all kinds of insects having no wings, may be preserved in spirits, brandy or rum, except crabs, lobsters, and the like, which may conveniently be preserved dry.

Under each class of insects, I shall relate the

mon, *ichneumon-fly*. Sphex, *ichneumon-wasp*. Vespa. Apis. (*b*) Mutilla, *naked-bee*. (*i*) Chrysis.

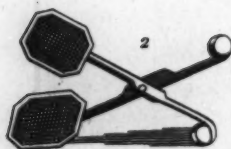
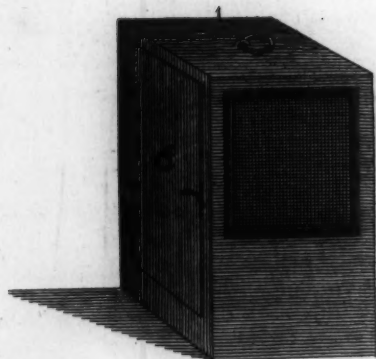
(*k*) Diptera, from *δύο* two, and *πτερον*, a wing, are such as have only two wings, and poisers, as in the fly, fig. 6. (*l*) Oestrus, *gad-fly*. Muica, *fly*. Tabanus, *whame*. Hippobosca, *horse-fly*.

(*m*) Tipula, Conops. Asilus, *wasp-fly*. (*n*) Bombylius, *flower-breeze*.

(*o*) APTERA, from *α*, without, and *πτερον*, a wing, insects having no wings, as the spider, fig. 7,

methods





methods of killing them the most readily, and with the least pain; as the pursuit of this part of natural history hath often been branded with cruelty; and however reasonably the naturalist may exculpate himself by pleading the propriety of submitting to an evil, which leads to useful discoveries, yet for wanton cruelty there never can be a just pretext.

—The poor beetle that we tread upon,
In corp'ral sufferance finds a pang as great
As when a giant dies (p).

I. The first class, consisting of beetle (coleoptera) are hard-winged. Many kinds fly about in the day, others in the evening, some at night only. They may be caught with a gauze net, (pl. 2, fig. 2.) or a pair of forceps covered with gauze (pl. 2, fig. 2). When they are taken, stick a pin through the middle of one of the hard wings, and pass it through the body, as in pl. 1. fig. 1, frontispiece. They may be killed instantly, by immersion in hot water, as well as in spirit of wine; then stick them on a piece of cork, and afterwards carefully place their legs in a creeping position, and let them continue exposed to the air until all the moisture is evaporated from their bodies. Beetles may also be preserved in spirit of wine, brandy or rum, closely corked up.

II. Insects of the second class (hemiptera) may be killed in the same manner as beetles, and likewise by means of a drop of the ethereal oil of turpentine applied to the head; or in the manner

(p) Shakespeare's Measure for Measure.

manner to be described under the next class for killing moths.

III. The division of butterflies and moths (lepidoptera) as well as all flies with thin membranaceous wings, should be caught with a gauze net, or a pair of gauze forceps: (see pl. 1, fig. 2) when taken in the forceps, run a pin through the thorax or shoulders, between the fore-wings, as in frontispiece, fig. 3. After this is done, take the pin by the head, and remove the forceps, and with the other hand pinch the breast of the insect, in order to deprive it of sensation and life: the wings of butterflies should be expanded, and kept so, by the pressure of small slips of paper, for a day or two. Moths expand their wings when at rest, and they will naturally take that position.

The larger kinds of these insects will not so readily expire by this method, as by sticking them upon the bottom of a cork exactly fitted to the mouth of a bottle, into which a little sulphur had been put, and by gradually heating the bottle till an exhalation of the sulphur takes place, when the insect instantly dies, without injuring its colours or plumage.

Perhaps the most easy method of killing moths and butterflies is by means of a needle made of steel fixed in an ivory handle, which must have passed through the body of the moth; the thumb and forefinger of the left-hand must be instantly placed on each side of the chest of the moth, just under the wings, when a squeeze will entirely deprive the insect of motion, and probably of sensation too for some minutes; these, however, will return

turn unless prevented by the following method.

The point of the needle must be passed through a small hole in thin brass, or tin plate, and then held in the flame of a candle for about half a minute, which will effectually destroy the life of the insect.

Although the idea of burning the insect to death may appear cruel at first sight, yet it should be remembered, that this is not done till after the insect has been deprived of sensation, by pressure first recommended; so that, on the whole, it appears to be the most easy and, speedy method of destroying them hitherto practised.

It is hardly necessary to add, that a brass or tin plate, for which a piece of card or paste-board may be substituted, is used to prevent the moth from receiving any injury from the candle.

The best method of having the most perfect butterflies, is to find out, if possible, the larva or caterpillar of each, by examining the plants, shrubs or trees they usually feed upon, or by beating the shrubs and trees with long poles, and thereby shaking the caterpillars into a sheet spread underneath to receive them; to put them into boxes covered with thin canvas, gauze, or cat-gut (pl. 2, fig. 1) and to feed them with the fresh leaves of the tree or herb on which they are found; when they are full-grown, they will change into the pupa, or chrysalis state, and require then no other care, till they come out perfect butterflies, at which time they may be killed, as before directed. Sometimes these in-

fects may be found hanging on walls, pales, and branches of trees, in the chrysalis state.

Moths might likewise be procured more perfect, by collecting the caterpillars, and breeding them in the same manner as butterflies. As the larvæ or caterpillars cannot be preserved dry, nor very well kept in spirit, it would be satisfactory if exact drawings could be made of them while they are alive and perfect. It may be necessary to observe, that in breeding these kinds of insects, some earth should be put into the boxes, as likewise some rotten wood in the corners, and some moss should be put upon it, which should always be kept damp; because, when the caterpillars change into the pupa, or chrysalis state, some go into the earth, and continue under ground for many months before they come out into the moth state; and some cover themselves with a hard shell, made up of small pieces of rotten wood. Hence also, as many go into the earth, valuable insects may sometimes be found by digging after them a foot deep, about the roots of trees, shrubs, and plants.

IV- The fourth class of insects (neuroptera) may be killed with spirit of wine, oil of turpentine, or by the fumes of sulphur.

V. Those of the next class (hymenoptera) may be killed in the same manner. A pin may be run through one of their wing-shells and body, as represented in pl. 1, fig. 5.

VI. Insects of the sixth class (diptera) may
likewise

likewise be killed by spirit, or by fumes of sulphur.

VII. Those of the last division (aptera) are in general, subjects which should be kept in spirit.

When in search of insects, we should have a box suitable to carry in the pocket, lined with cork at the bottom and top to stick them upon, until they are brought home. If this box be strongly impregnated with camphor, the insects soon become stupefied, and are thereby prevented from fluttering and injuring their plumage. Besides a gauze forceps (pl. II, fig. 7) the collector should have a large musquito gauze net, made in the shape of a bat fowling-net, (pl. II, fig. 3) and also a pin-cushion with three or four different sizes of pins to suit the different sizes of insects.

In hot climates, insects of every kind, but particularly the larger, are liable to be eaten by ants and other small insects, especially before they are perfectly dry; to avoid this, the piece of cork on which our insects are stuck in order to be dried, should be suspended from the ceiling of the room, by means of a slender string or thread; besmear this thread with bird-lime, or some adhesive substance, to intercept the rapacious vermin of these climes in their passage along the thread.

After our insects are properly dried, they may be placed in the cabinet or boxes where they are to remain: these boxes should be kept dry; and also made to shut very close, to prevent small insects from destroying them; the bottoms of the boxes should be covered with pitch, or green wax, over which paper may be laid; or, which

is better lined with cork, well impregnated with a solution of corrosive sublimate mercury.

The finest collections have been ruined by small insects, and it is impossible to have our cabinets too secure. Such insects as are thus attacked may be fumigated with sulphur, in the manner described for killing moths; if this prove ineffectual, they may be immersed in spirit of wine, without much injuring their fine plumage or colors; and afterwards let them be sprinkled about their bodies and insertions of the wings with the solution above-mentioned. But baking the insects in an oven in the manner to be described in the next section for birds, is the most effectual method of extirpating these enemies; however the utmost caution is requisite in this process, in regulating the heat of the oven.

These observations and directions respecting insects, may, perhaps, be the means of exciting the curiosity of some, whose inquiries after this part of natural history will be amply compensated by the frequent opportunities of enlarging their knowledge, as there is scarce any part of the surface of this globe, scarce a tree, a shrub, or a plant, an animal either living or dead, or even the excrements of animals, on which some kind of insect does not depend for its subsistence and propagation.

—— The flowery leaf
 Wants not its soft inhabitants. Secure,
 Within its winding citadel, the stone
 Holds multitudes. But chief the forest-boughs,
 That dance unnumber'd to the playful breeze,
 The downy orchard, and the melting pulp
 Of mellow fruit, the nameless nations feed
 Of evanescent insects. Where the pool
 Stands mantled o'er with green, invisible,
 Amidst the floating verdure, millions stray.
 Each liquid too, whether it pierces, soothes,
 Inflames, refreshes, or exalts the taste,
 With various forms abounds. Nor is the stream
 Of purest crystal, nor the lucid air,
 Though one transparent vacancy it seems,
 Void of their unseen people——(7).

(7) Thomson's Seasons, SUMMER, l. 296.

SECT.

SECT. II.

Method of preserving BIRDS and other Animals,

Vitam excoluere per Artes.

VIR. ÆN. 6. v. 663.

THE general increase of knowledge of late in natural history, from the attention of individuals to various branches of it, must afford no small degree of pleasure to the sensible part of mankind. Whilst such different researches have given entertainment to different dispositions, enlarged the mind, and engaged and diverted it from unprofitable or dangerous pursuits, they have occasionally given rise to the most useful improvements in every department of life, and afforded means of joining utility with elegance.

To promote these purposes more effectually, a more general knowledge of a good antiseptic for animal substances has been much enquired after. Owing to a want of this, many curious animals, and birds particularly, come to our hands in a very imperfect state: some from foreign parts entirely miscarry, and others of the finest plumage are devoured by insects.

To

To promote these purposes more effectually, a knowledge of the means of preserving birds and other animals must be highly desirable. The methods made use of, by captain Davies, and T. S. Kuckahn, have been published in the philosophical Transactions (r).

The former directs birds in perfect plumage,
 “ to be opened from the upper part of the breast
 “ to the vent, with a sharp knife, or pair of scissars,
 “ the feathers of the breast and belly being first
 “ carefully laid aside by the fingers, so as not to
 “ hinder the skin being easily come at. The
 “ skin must then be carefully loosened from all
 “ the fleshy parts of the breast, body, thighs,
 “ and wings; after this, cut off all the flesh from
 “ those parts, and take out also the entrails and
 “ all the inside; then, having got a composition
 “ of burnt alum, camphor, and cinnamon, of each
 “ an equal quantity, well powdered and mixed
 “ together; strew some of this powder lightly
 “ over the whole carcase; but salt is by no
 “ means to be used in this composition, as it al-
 “ ways will drop and nasty the plumage in moist
 “ weather: pour also into the body a small
 “ quantity of camphor dissolved in rectified spi-
 “ rits of wine; after that, fill up the cavity with
 “ fine cotton, or any soft woolly substance, pour-
 “ ing some of the aforesaid spirits into the cot-
 “ ton or stuffing. Open next the mouth, and
 “ with a pair of scissars take away the tongue,
 “ the roof of the mouth, eyes, brains, and in-
 “ side of the head; fill that also with the same
 “ composition; and, having procured eyes as
 “ near the natural ones as possible, put them

(r) Vol. IX. anno 1770, p. 184, and 302.

into

" into the sockets by means of a small pair of
 " nippers introduced at the mouth. The eyes
 " will be best made by letting fall some drops
 " of black sealing wax on a card of the size of
 " the natural ones (s); the card must be cut
 " something larger than the wax, to prevent
 " their falling out of the head. Fill the head
 " quite full with cotton, pouring some of the
 " spirits down the throat, with some of the pow-
 " der; a small piece of brass wire, that has been
 " heated in the fire to make it pliable, may be
 " put down the throat, being passed through one
 " of the nostrils, and fastened to the breast bone,
 " to place the head in any attitude you choose;
 " next fill up the body, where the flesh has been
 " taken away, with cotton and your composition;
 " and having a fine needle and silk, sew up the
 " skin, beginning at the breast, observing, as you
 " approach towards the vent, to stuff the skin as
 " tight as it will bear. This will be easiest ac-
 " complished by means of a small piece of stick
 " or ivory, like a skewer, till the whole is done:
 " then lay your feathers of the breast and belly in
 " their proper order, and your bird will be com-
 " pleted. If you would chuse to put it into an
 " attitude, by introducing a small piece of the
 " wire above-mentioned through the sole of
 " each foot up the leg, and into the pinion of

(s) Wax is not a proper substance for eyes; there are persons
 in London, whose business it is to make glass eyes of any size or
 colour, at a trifling expence, but as these cannot be had in voy-
 ages, it would be proper, while the bird is fresh, to take a drawing
 of the eyes in colours.

"each wing (*u*) it may be disposed of as you please."

Instead of using the solution of camphor in spirit of wine, Kuckahn recommends a liquid varnish, made of two pounds of common or raw turpentine, one pound of camphor, and one pound of spirit of turpentine. The camphor is to be broke into very small pieces, and the whole is to be put into a glass vessel, open at top, which is to be placed in a sand heat, till the ingredients are perfectly dissolved.

For the dry compound of cinnamon, burnt alum, and camphor, directed in the foregoing method, he substitutes the two following compositions.

Corrosive sublimate,	—	—	$\frac{1}{4}$ lb.
Saltpetre prepared or burnt,	—	—	$\frac{1}{2}$ lb.
Alum burnt,	—	—	$\frac{1}{4}$ lb.
Flowers of sulphur,	—	—	$\frac{1}{2}$ lb.
Musk (<i>x</i>),	—	—	$\frac{1}{4}$ lb.
Black pepper,	—	—	1 lb.
Tobacco ground coarse.	—	—	1 lb.

(*u*) The late Mr. Leman, who was remarkable for the easy attitude of his birds, passed a wire sideways through one wing into the breast-bone, the other end of the wire being fastened into the box inclosing the bird.

(*x*) The musk renders this composition very expensive for which the same quantity of camphor or myrrh might be substituted.

D

Mix

Mix the whole together, and keep it in a glass vessel stopped close. Some of this is to be strewed upon the inside of the skin and cavity of the head, after they have been washed with the varnish.

The other dry composition (y) is made of equal quantities of tanfy, wormwood, hops, and tobacco, which are to be cut small and mixed together; with this the cavities of the craw and body are to be stuffed. He likewise directs an artificial breast to be made of soft wood, and fitted to the proper place, after being moistened with the varnish (z).

I thought it might be acceptable to lay before the reader, the above methods, which were practised some years since in this country; but at present, a very simple one is pursued, which is at the same time preferable.

In preserving all animals, the principal objects should be to remove not only the flesh of the subject but likewise as much as possible, the bones, which are equally liable to putrescency, and to invite insects. In short, after opening the bird,

(y) This is entirely useless, and forms a less soft and smooth stuffing than cotton or tow, which on that account are preferable. The reader will observe the difficulty and expence of following this complex method recommended by Kuckahn; it is indeed surprising that his prolix directions should be admitted at large into the Philosophical Transactions.

(z) It must be almost impracticable to proportion an artificial breast exactly of the natural size and shape; cotton or tow answers every purpose with less trouble;

by

by a longitudinal incision from the breast to the vent, not only the brain and fleshy parts, but likewise all the bones, except those of the legs, and the arch of the skull, should be removed: the skin is then to be stuffed with a sufficient quantity of cotton or tow, to give the subject its natural size.

Were the inside surface of the skin to be sprinkled with the dry antiseptic powder before-mentioned, or with tobacco-dust, it might probably be some preservative against insects; but it is not at this time an usual practice, experience having shewn that the removal of the flesh and bones affords the best security.

To exhibit the bird in its proper attitude, there should be some substitute for the back-bone, in order to give firmness to the subject; for this purpose brass-wire nealed, (that is heated, in the fire, which makes it pliable and retain any form into which it is bent), or a thin piece of lead, may be passed down the throat, or through one of the nostrils, quite to the vent; this should be done, before, or at the time of introducing the cotton or tow. Wires must next be introduced through the feet and legs, or between the bone and skin of the latter, and fastened to the longitudinal wire or lead, passing from the head to the vent; the other ends of the wire may be fixed in the perch or board, on which the subject is to remain.

Having then carefully sewed up the skin, and placed the bird in the attitude we purpose it to retain; it should next be exposed to a dry air, or

to the warmth of an oven heated to a very moderate degree, and it will soon acquire a firmness which it will afterwards retain; and when this is effected, it should be fixed in a box, secured from insects, glazed in front to exhibit the preparation to view.

When persons are on long voyages, they have seldom leisure or convenience to go through this process; and indeed were they to effect it, it would be difficult to preserve the subject from insects.

Under any embarrassment of this kind, birds and other animals, particularly small ones, may be put into brandy, wine, arrack or first runnings, without being skinned; and the whole process of preparation just described, may be executed when the traveller arrives in port.

Large Sea-fowl have thick strong skins, and such may be skinned; the tail, claws, head, and feet, are carefully to be preserved, and the plumage stained as little as possible with blood.

Baking in a mild heat is not only useful in fresh preservations; but, will also be of great

(a) Linné describes another method of preserving fish; this is to expose them to the air, and when they acquire such a degree of putrefaction, that the skin loses its cohesion to the body of the fish, it may be slid off almost like a glove; the two sides of this skin may then be dried upon paper like a plant, or one of the sides may be filled with plaster of Paris, to give the subject a due plumpness. Vid. *Amæn. Acad.* Vol. III. A fish may be prepared, after it has acquired this degree of putrefaction, by making a longitudinal

service

service to old ones, in destroying the eggs of insects, if they be suspected.

Small quadrupeds, all kinds of reptiles, as snakes, lizards, and frogs; fish (*a*) of all sorts and small tortoises, with sea eggs (*b*), and sea stars, may be put into brandy, rum, arrack, or first runnings, with the addition of a little alum.

Shells constitute an extensive part of natural history, and may be collected in great plenty and variety on the shores of most islands and continents. Those which are found with the fish in them, are the most valuable for the brightness of colour, and smoothness of surface, as they lose that beauty and polish, when they have been long exposed to the sun. In bivalves, or those having double shells, as cockles, oysters, &c. both the shells should always be collected. It is sufficient in packing up shells, to prevent their rubbing against each other, which may be effected by means of paper, moss, sand, &c. Some of the shell-fish may be preserved in spirits, as this might prove an useful addition to the knowledge of this department of natural history.

incision on the belly, and carefully dissecting the fleshy parts from the skin, which are but slightly attached to it in consequence of the putrescency; the skin is then to be filled with cotton and tow, as directed for birds, and lastly to be sewed up where the incision was made.

(*b*) The echini, or sea eggs, may also be dried; they are however liable to be broken.

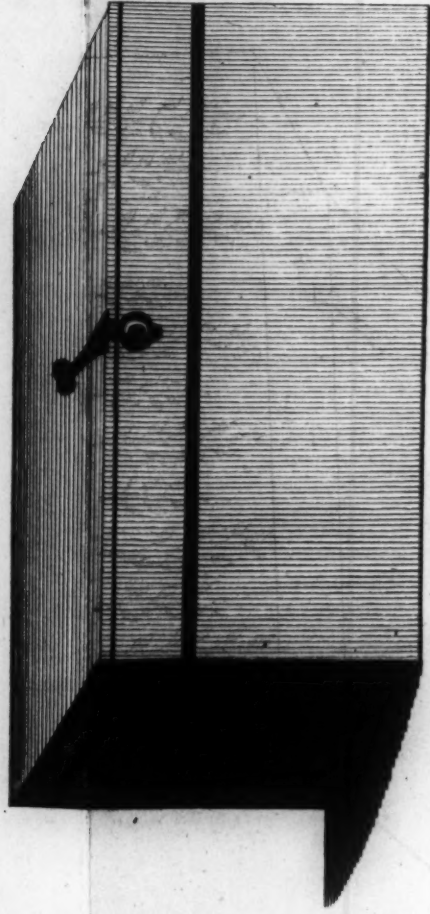
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The nests and eggs of birds, would likewise contribute to increase the knowledge of natural history, and prove also highly ornamental among collections in that branch of zoology.

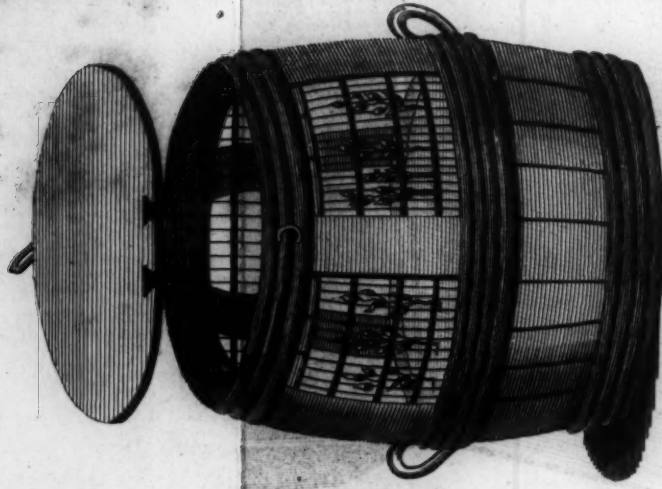




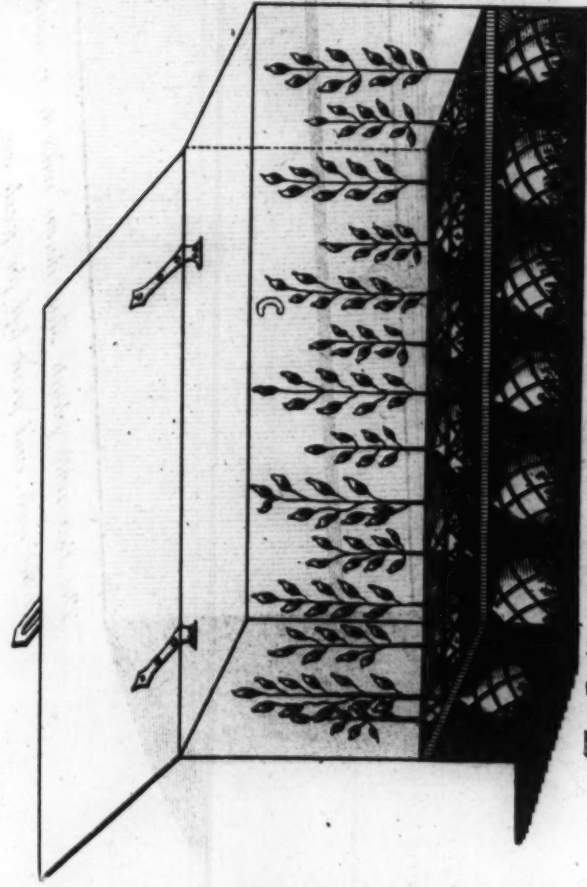
Boxes for conveying Plants by Sea.



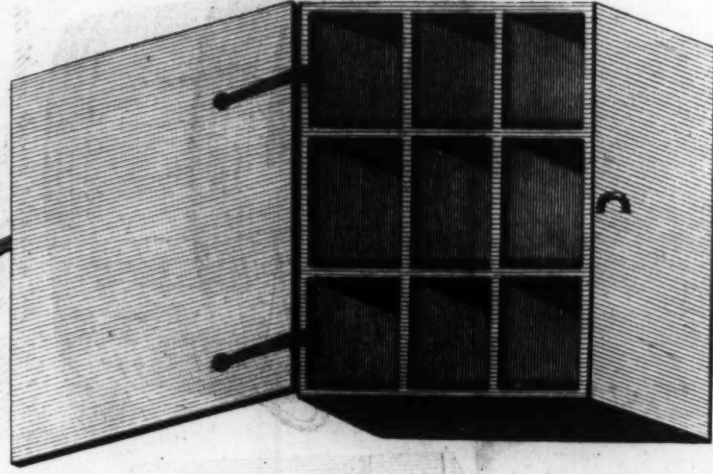
The Box with plants shut down with the openings at the ends and front left for fresh air.



The Cask for sowing seeds with the openings defended by Wire.



The Inside of the box showing the manner of sowing the roots of plants surrounded with earth & mops tied with packthread and fastened cross & cross with laths or packthread to keep them steady.



The Box with divisions for sowing different seeds in earth & not mops.

SECT. III.

*Directions for bringing over Seeds and
Plants from distant Countries.*

Nor ev'ry plant on ev'ry soil will grow ;
The fallow loves the watry ground, and low ;
The marshes, alders : Nature seems t' ordain
The rocky cliff for the wild ash's reign ;
The baleful yew to northern blasts assigns ;
To shores the myrtles ; and to mounts the vines (c)

EVERY part of the world has its peculiar productions ; and in no objects of natural history, is the variety more entertaining, and important than horticulture.

The gardens of the curious have already been enriched with many valuable acquisitions from distant countries ; but many attempts also to introduce several other plants equally rare, have been unsuccessfully made, owing to the bad state of the seeds or plants when first procured, or the method of disposing of them during long

(c) Nec vero terræ ferre omnes omnia possunt.
Fluminibus salices, crassisque paludibus alni
Nascuntur, steriles saxosis montibus orni.
Littora myrtetis lætissima : denique apertos
Bacchus amat colles ; aquilonem et frigora taxi.

VIRG. G. II. 109.

voyages ;

voyages; and such accidents as the utmost precaution cannot prevent.

For the purpose of transportation, ripe seeds should be chosen, which have been collected in dry weather, and kept dry without exposing them to sunshine; and internally they should be plump, white, and moist.

Attention to the state of the seeds of Chinese plants is peculiarly requisite, as there is reason to suspect that more seeds from China miscarry from the art and treachery of the natives, than from the distance, or any defect in conveying them; as many seeds are brought over, which appear to have been roasted by the Chinese, previous to disposing of them, in order to prevent their vegetation, and thereby keep up the demand. To discover the healthy state of the seeds, some of the larger ones may be cut across, and the smaller ones bruised, and by means of a magnifying glass, or even by the naked eye, it may be discovered, whether their internal part which contain the seminal leaves, appear plump, white and moist. If so, we may conclude they possess a vegetating state; but if they are shrivelled, inclining to brown or black, and are rancid, they cannot in the least be depended upon.

(a) Seeds thus carefully selected, may be preserved by rolling each in a coat of yellow bees-wax, about half an inch thick; and afterwards a number of these, thus prepared, may be put into a chip-box, which is to be filled with melted bees-wax, not made too hot: the outside of the box may then be washed with a solution of

of sublimate mercury (*d*), and kept during the passage in a cool airy place. In this manner tea-seeds, the stones of mangoes, and all hard nuts and leguminous seeds in general, may be prepared.

(*b*) Instead of putting small seeds in bees-wax, they may be enclosed in paper or cotton which has been first steeped in melted bees-wax, and then placed in layers in a chip-box, some of which may be filled as before with melted bees-wax. Pulpy seeds, as those of strawberries, mulberries, arbutuses, &c. may be squeezed together and dried, and then put into the cerate-paper or cotton above-mentioned.

(*c*) Small seeds, may also be mixed with a little dry sand, put into the cerate-paper or cotton, and packed in glass-bottles, which are to be well corked, and covered with a bladder or leather (*e*).

(*d*) Sublimate mercury is the most effectually dissolved in the acid of sea-salt; one drop of which will dissolve one grain of mercury, which will afterwards mix with water. One drachm of sublimate will be sufficient for half a pint of water. — Corrosive sublimate may likewise be dissolved in a saturated solution of sal ammoniac in water, one ounce of which will dissolve twenty scruples of sublimate.

(*e*) This may be compared with what Dr. Hawkesworth observes in his *Voyages*. vol. ii. p. 123. "On the 10th I put some seeds of melons, and other plants, into a spot of ground which had been turned up for the purpose: they had all been sealed up, by the person of whom they were bought, in small bottles, with rosin, but none of them came up except mustard; even the cucumbers and melons failed, and Mr. Banks is of opinion that they were spoiled by the total exclusion of fresh air." Some seeds which I received from North America, enclosed in corked bottles, have since been sown, and germinated. See *g*.

E

These

These bottles may be put into a keg, box, or any other vessel, filled with four parts of common salt, two of saltpetre, and one part of sal ammoniac; or common salt alone, if the others cannot be procured, in order to keep the seeds cool, and preserve their vegetative power.

(d) Seeds and nuts, in their pods, may be enclosed in linen or writing-paper, and put into canisters, earthen-jars, snuff-boxes, or glass-bottles; the interstices between the parcels of seeds should be filled with whole rice, millet, panic, wheat-bran, or ground Indian-corn well dried. To prevent any injury from insects, a little camphor, sulphur, or tobacco, should be put into the top of each canister or vessel, and their covers well secured, to exclude the admission of the external air.

(e) Seeds, well dried, may be put into a box, not made too close, upon alternate layers of moss, in such a manner as to admit the seeds to vegetate, or shoot their small tendrils into the moss. In the voyage the box may be hung up at the roof of the cabin, and when the ship is at the place of her destination, the seeds should be put into pots of mould, or boxes, with a little of the moss also about them, on which they had lain.

(f) After every other precaution in transporting seeds has failed, I have known instances of their having been brought from distant parts, even from Botany-Bay, and Norfolk-Island, by the circuitous voyage of the East-Indies, in a perfect state of vegetation, which have been merely wrapped in common brown-paper; and as it is
the

the easiest and perhaps best method of conveying seeds, it should never be neglected: American seeds are usually brought over in this manner. The Chinese paper is generally employed for seeds from the East-Indies, and is probably as good as our common blotting and brown-paper.

Seeds preserved after the manner (e), (f), as well as that of (d), and likewise, for further security, some of the preceding (a), (b), (c), which have been procured in the East-Indies, may be examined when the ship arrives at St. Helena; and some of them, which appear in a state of vegetation, should be sown in the annexed boxes of earth, between the growing plants, as many sorts as possible; some of which may succeed in case of failure of the plants.

More of the same seeds may be also sown after the ship has passed the Tropic of Cancer, near the latitude of thirty degrees north. And if very small bits of broken glass are mixed with the earth, or thrown plentifully over its surface in the boxes, it may prevent mice and rats from burrowing in it, and destroying the tender roots of the plants and growing seeds.

In whatever method our seeds have been preserved, it should be a constant precaution to sow them as soon as they have been exposed to the external air, otherwise they probably will never vegetate.

In order to take up plants or shrubs advantageously, that are to be transported, a mattock and a spade should be provided; with the mattock a small trench should be opened round the plant intended to be taken up; the spade

should then be put under the root, which must be lifted up with a large ball of earth surrounding it; and if it should fall off, it must be supplied with more earth, so as to form a ball about the roots of each plant, which must be surrounded with wet moss, and carefully tied about with pack-thread to keep the earth about the roots moist: loamy earth will continue moist the longest.

Of each kind the youngest plants of shrubs and trees that can be found, should be taken; none of them should be above a foot high; as young plants are found by experience to bear removing much better than old ones.

Convenient boxes for the conveyance of plants in long voyages, are made about four feet long, two broad, and two deep; these, when half filled with earth, can be conveniently carried by two men holding the rope-handles fixed to their ends. pl. III. fig. 1. 2. 3.

These should be filled about half full of mould, with a few rotten sticks or leaves at the bottom, and the plants intended to be sent, planted in it, as soon after the ship's arrival as possible. When the ship is about to sail, and they are sent on board, hoops are to be nailed to the sides of the box, in such a manner, that, arching over it, they may cover the highest of the plants; small ropes are to be twisted between these, in the form of a net, to prevent the dogs or cats from getting at them, and scratching them up, on account of the fresh mould.

For each box so hooped and hedged, provide a canvas cover, which may, when put on, entirely protect

BOXES for conveying PLANTS by Sea.

Fig. 1.

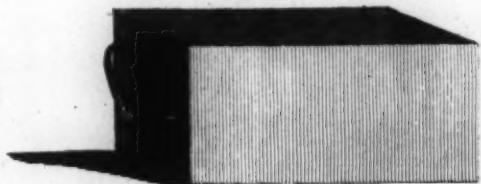


Fig. 2.

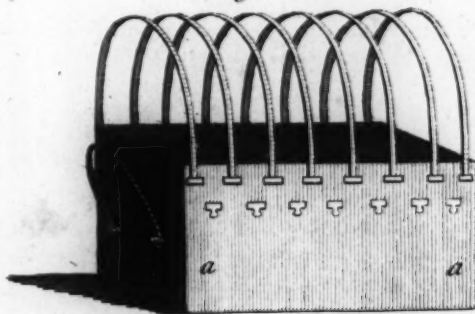
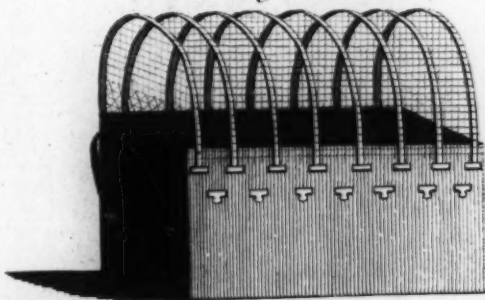


Fig. 3.



F. 1. Form of the Box .

2. The same with hoops and loops .
a. a. for securing the Canvas .

3. The same netted .



protect it ; and, to prevent this cover from being lost or mislaid, nail it to one side, and fix loops or hooks to the other, by which it may occasionally be fastened down.

The late J. Ellis, Esq. who took singular pains to promote the introduction of Exoticks, recommends the construction of a box and cask agreeable to pl. IV. fig. 1. 2. The first shews the inside of the box, and the manner of securing the roots of plants surrounded with earth and moss tied with pack-thread, and fastened cross and cross with laths or packthread to keep them steady.

There must be a narrow ledge nailed all round the inside of the box, within six inches of the bottom, to fasten laths or packthread, to form a kind of lattice-work, in order to secure the plants in their places, as abovementioned.

The cask fig. 2. is convenient for sowing of seeds, with the openings defended by wire ; and as every ship has spare casks, one may be readily formed for the conveyance of seeds in vegetation or growing plants, agreeable to the annexed engraving. The following is the proportion it should be of ; two feet three inches high, two feet bung diameter, and one foot nine inches head diameter ; there should be a large opening at the top wired over, the wired part of which might be lifted up at pleasure, and a lid with hinges to cover it ; this may be either circular or square, as will be most convenient, the larger the better ; and on the upper part of the sides there may be four or five little openings wired, with doors to each, for the sake of giving air all round upon some occasions.

Care

Care must be taken not to expose the young plants to strong sunshine: sometimes, when the lid and doors are open, it may be necessary to throw a matt or thin cloth over them, but this must depend on the judgment of the person who has the care of them; there should be handles fixed to the sides, to move it with more safety.

There should be a layer of wet moss, of two or three inches deep, at the bottom of the box or cask; or, if that cannot be got, some very rotten wood or decayed leaves, and then fresh loamy earth, about twelve inches deep, both of which will sink to a foot deep: the wet moss is intended to retain moisture, and to keep the earth from drying too soon.

The surface of the earth should be covered with moss cut small, which now and then on the voyage should be washed in fresh water, and laid on the earth again to keep the surface moist, and to wash off mouldiness or saline vapours which may have settled on it. When the plants come up, it will be proper to save what rain-water can be got, which will encourage their growth, and be of more service than the water drawn out of casks that have been long on board the ship.

These kind of boxes or casks will be very proper to sow many sorts of such seeds in, as are so difficult to be brought from China, and other parts of the East-Indies, to Europe in a vegetative state; such as the lechec, mangoes, mangosteens, pepper, marking-nuts, various sorts of peaches, roses, oranges, citrons, lemons, &c.

If the plants sent from these countries were planted in pots or boxes, and kept there a year, they might be brought over with very little hazard; or even if they were first transplanted from the woods into a garden, till they had formed roots, they might be sent with much more safety.

The captain who takes charge of them, must be particularly informed, that the chief danger plants are liable to in sea-voyages, is occasioned by the minute particles of salt-water with which the air is charged, whenever the waves have white frothy curls upon them; these particles fall upon the plants, and quickly evaporating, leave the salt behind, which, choaking up the pores, prevents perspiration, and effectually kills the plant; he therefore should never let the covers be off, except on days when the wind is not sufficiently high to beat the water up into what the seamen call white-caps. He must not keep them always shut up during the voyage; for if he does, they will mould and perish by the stagnation of the air under the covers: and if at any time, by accident or necessity, they should have been exposed to the wind when the waves have white-caps, he must be desired to water them well with fresh water, sprinkling all the leaves with it, to wash off the salt-drops which cover them. In this manner plants may be brought from almost any distance; many come from China every year in a flourishing state.

If it be convenient to the captain to give up a small part of the great cabin to the plants, this is certainly by far the best station for them; nor
are

are they much in the way as the place which suits them best is close to the stern windows; in this case they need not be furnished with their canvas covers; and they may frequently have air, by opening the windows when the weather is quite moderate.

As the Chinese ingraft many plants which they introduce into their dwelling-houses, and which may be purchased in a healthy state of vegetation, it is a necessary caution, not to earth such plants in the passage too high with mould, as they are thereby liable to rot, or be otherwise injured by such means. The rolling of the ship has sometimes removed the earth, in which they are planted, and many fine collections have been destroyed by replacing the earth too high on the stems, particularly of such plants as have been engrafted, a practice very general with the Chinese.

From the frequent inconvenience of the rolling of ships, which sometimes unearths the plants, or otherwise injures them; were the boxes or pots to stand upon a stage, moveable like the mariner's compass, it would certainly afford the best conveyance: this was prepared at considerable expence, in the vessel commanded by Captain Bligh, to convey the bread-fruit tree, and other vegetables from the South-Seas: the plants he had procured were in high health, when this laudable and princely plan was frustrated by a mutiny on board, to be lamented by every man of science and philanthropy. In merchants ships, where commerce is the object of the voyage, and where space and convenience

ence can seldom if ever be commanded; and therefore the plan of a moveable stage cannot here be expected: from a munificent prince the combination of a company, or a society, we must look for the support of such an enterprize.

One method of procuring plants from China has been successfully adopted by that liberal promoter of horticulture Gilbert Slater Esq. which may be introduced here. He has ordered every curious drawing of Asiatic plants by Chinese artists to be procured for him, in the power of sea-faring gentlemen; these drawings are in general not only elegant and accurate; but severally distinguished by their names in Chinese characters: the characters are copied on Chinese paper, which being thin and almost transparent, may be accurately traced, and such as refer to rare productions, are distributed to captains of ships, and other persons undertaking voyages, with directions to purchase such living plants, as correspond with the character. Sometimes these are accompanied with the drawings themselves. By this circuitous but advantageous mode, in a few years he will acquire a collection of valuable plants, at present not known in Europe.

It is much to be regretted, that after the most scrupulous attention in collecting and transporting very valuable plants, they shall ultimately be lost by the tedious process of our Custom-house, employed to prevent smuggling. I once saw some fine plants, for which I should have deemed fifty guineas a cheap purchase, totally spoiled

F

by

by being kept there a full month, without any care whatever, not receiving the least sprinkling of water, whilst the Thames flowed within twenty yards of their prison. This does not result from any malicious design of the officers, who in their vigilance to prevent smuggling, thus occasion the loss of property, that might not only gratify laudable curiosity, but enrich our possessions with new products of importance in food, or arts. At this moment I am suffering under the injury that a collection of Asiatic insects have sustained, of which I do not expect to receive one in a perfect state.

A plan might be adopted, not only to obviate this painful inconvenience, but at the same time encrease rather than lessen the revenue, by giving power to the commissioners of the customs to appoint gentlemen of taste and knowledge in natural history, whose valuation of such subjects shall govern the duties, which are usually taken ad valorem; and on payment, that the proprietors be permitted to remove their property at pleasure. That gentlemen might be found to make these valuations gratuitously I doubt not; and as to the revenue on such subjects, I know it would not suffer, for many things are, at present, not only spoiled or totally destroyed, but much undervalued by ignorant persons, many proofs of which I have in my recollection.

When the naturalist is in search of vegetable productions, different soils and situations should be examined; as the sea, and its shores, deep running waters, dikes, marshes, moors, mountains,

tains, cultivated and barren fields, woods, rocks, &c. afford each their peculiar plants; and wherever any are collected, the particular soil and situation should be remarked. Sometimes it may prove inconvenient to convey the plants which may be discovered, when it would not be so to send them dried, in the form of a hortus-ficcus. To do this in the best manner, and to make their stalks, leaves, &c. lie flat and smooth, "The plants should be gathered in a dry day, "after the sun hath exhaled the dew; taking "particular care to collect them in that state "wherein the generic and specific characters are "most conspicuous; the specimens should be "suffered to lie on a table until they become limber, and then they should be laid upon a pasteboard, as much as possible in their natural form, but at the same time with a particular view to their generic and specific characters: "for this purpose, it will be adviseable to separate one of the flowers, and to display the generic character: if the specific character depends upon the flower, or upon the root, a particular display of that will be likewise necessary. When the plant is thus disposed upon the pasteboard, cover it with eight or ten layers of spongy paper, and put it into the press (f).

(f) "The press may be prepared by the following directions. "Take two planks of a wood not liable to warp, two inches thick, eighteen inches long, and twelve inches broad. Get "four male and four female screws, such as are commonly used for securing sash windows. Let the four female screws be let

“ Exert only a small degree of pressure for the
 “ first two or three days; then examine it, un-
 “ fold any unnatural plaits, rectify any mistakes,
 “ and after putting fresh paper over it, screw the
 “ press harder. In about three days more, se-
 “ parate the plant from the pasteboard, if it is
 “ sufficiently firm to allow of a change of place;
 “ put it upon a fresh pasteboard, and covering it
 “ with fresh blossom-paper, let it remain in the
 “ press a few days longer. The press should
 “ stand in the sunshine, or within the influence
 “ of a fire.

“ When it is perfectly dry, the usual method
 “ is to fasten it down with paste or gum-water (g),
 “ on the right-hand inner page of a sheet of

“ into the four corners of one of the planks, and correspond-
 “ ing holes made through the four corners of the other plank,
 “ for the male screws to pass through, so as to allow the two
 “ planks to be screwed tightly together. It will not be amiss
 “ to face the bearing of the male screws upon the wood with
 “ iron plates; and if the iron plates went across from corner
 “ to corner of the wood, it would be a good security against
 “ the warping.”

This note I have copied from Dr. Withering's Botanical
 arrangement, and likewise the account of drying plants,
 as his directions are more full and complete than those I for-
 merly introduced into my Naturalist's Companion, An. 1772.
 Where the convenience of this press is not at hand, a suitable
 pressure may be made by weights, or any heavy body.

(g) “ A small quantity of finely-powdered arsenic or corrosive
 “ sublimate is usually mixed with the paste or gum-water, to
 “ prevent the devastations of insects; but the seeds of staves-
 “ acre, finely powdered, will answer the same purpose, without
 “ being liable to corrode, or to change the colour of the more
 “ delicate plants.”

“ large

“ large strong writing-paper. It requires some
 “ dexterity to glue the plant neatly down, so that
 “ none of the gum or paste may appear to defile
 “ the paper. When it is quite dry, write upon
 “ the left-hand inner page of the paper, the name
 “ of the plant, the specific character, the place
 “ where, and the time when, it was found ; and
 “ any other remarks that may be thought pro-
 “ per. Upon the back of the same page, near
 “ the fold of the paper, write the name of the
 “ plant, and it will then be complete for the
 “ cabinet.”

“ Some people put the dried plants into sheets
 “ of writing paper, without fastening them down
 “ at all ; and others only fasten them by means of
 “ small slips of paper, pasted across the stem or
 “ branches.

“ Another more expeditious method is, to take
 “ the plants out of the press, after the first or
 “ second day ; let them remain upon the paste-
 “ board ; cover them with five or six leaves of
 “ blotting-paper, and iron them with a hot
 “ smoothing iron, until they are perfectly dry :
 “ if the iron is too hot it will change the co-
 “ lours ; but some people, taught by long practice,
 “ will succeed very happily. This is quite the
 “ best method to treat the orchis, and other slimy
 “ mucilaginous plants.

“ Another method is, to take the plants when
 “ fresh gathered, and, instead of putting them
 “ into the press, immediately to fasten them down
 “ to the paper, with strong gum-water ; then dip

“a camel-hair pencil into spirit-varnish (*h*), and
 “varnish the whole surface of the plant two or
 “three times over. This method succeeds very
 “well with plants that are readily laid flat;
 “and it preserves their colours better than any
 “other.”

However beautiful a collection of dried plants may appear in the form of a hortus-ficcus, yet where duplicates can be procured, it would be acceptable to receive plants both in flower, and in seed, dried in a careless manner, without nicety in expanding their foliage: by this means some of the flowers have been preserved more entire; and afforded the botanist the most accurate characters of the plant, which by exposure to the vapour of hot water, or being soaked in lukewarm water itself, has expanded, and exhibited the parts of fructification in the most perfect state.

The seeds of a plant collected when they are ripe, will in a hortus-ficcus, long retain their vegetative powers, and many of our valuable plants have thus been casually introduced. It is well known, that the first green-tea-tree possessed by this country, was raised by the late John Ellis Esq. from a seed picked out of a cannister of tea.

(*b*) The spirit-varnish may be made of a quart of highly-rectified spirit of wine, five ounces of gum sandarach, two ounces of mastich in drops, one ounce of pale gum elemi, and one ounce of oil of spike lavender: these are to stand in a warm place, and be shook frequently, to expedite the solution of the gum.

The

The impressions of plants well taken off upon paper, look very little inferior to the best drawings, and may be done with very little trouble. For this purpose, some printer's ink (*i*), and a pair of printer's balls, such as are used for laying the ink on types, are necessary. After rubbing these balls with a little of the ink, lay the plant betwixt them, and press it so as to give it sufficient colour; then take the plant and lay it carefully on a sheet of paper, and press it with the hand, to give the impression of the plant to the paper, which may be afterwards coloured according to nature; a piece of blotting-paper may be placed betwixt the plant and the hand, to prevent the latter from being dirtied by the ink.

An effectual method of sending a branch of any plant, with the flowers and parts of fructification entire and perfect, is to put them in bottles of brandy, rum, or arrack; but the colour of the plant is often injured.

Corals, corallines, sponges, &c. inhabitants of the sea, are found in considerable variety near the coasts of islands and continents, particularly in hot climates. Some of these are very tender and brittle when dry, and should therefore be carefully packed up in sand, in order to keep them steady, or placed betwixt papers in the manner of an hortus-ficcus.

In hot climates, the insects are very rapacious and I have seen the finest fan-corals, and others of a soft texture when first taken out of the sea,

(*i*) Where this cannot be procured, ivory, or lamp-black, ground with boiled linseed-oil, may be substituted.

almost

almost devoured by ants, before they became dry and hard. To prevent injuries of this kind, a little powdered corrosive sublimate, arsenic, or stavesacre, may be sprinkled upon these productions. Some of the small, and branches of the large ones, might be also put into spirits, and the parts of them thereby preserved much more distinct; which would serve greatly to illustrate their natural history.



SECT. IV.

Method of Analyzing Mineral Waters (a).

Qui autem ad observandum adjicit animum; ei etiam, in rebus
quæ vulgares videntur, multa observatu digna occurrunt.

Bacon, de Augment. Scient.

AS many springs contain a volatile principle, soon liable to be dissipated, it is necessary to make our experiments on the spot, in order to discover the contents of such waters. Various as these contents may appear, the apparatus proper to detect them, may be reduced into a small compass.

When we purpose to examine any mineral or medicinal spring, the soil and face of the country should be considered, the stony or mineral appearance, and particularly whether there are any mineral veins: the degrees of heat of the water should be ascertained by a thermometer, and its comparative weight to other springs in

(a) Wallerius in his *Hydrologia*, Lewis in his notes on Neumann's *Chemistry*, with Rutt, Lucas, Falconer, Monro, Pearson, Garnett, and other English writers, have given directions on this subject, which some late chemical writers on the continent have further elucidated, as Wiegand, Bergman, Strachling, Struve, Westrumb, and Gottling.

the neighbourhood also carefully observed; after which we may enter on our experiments.

From the substances contained in mineral waters, they admit of the four following divisions.

I. ACID AND NEUTRAL SALTS.

II. EARTHY SALTS.

III. METALLIC SALTS.

IV. SULPHUREOUS.

I. ACID AND NEUTRAL SALTS.

More eminently saline, containing the acids, and the compound of acids and alkalis forming neutral salts.

1. Fixed air * the only acid found in any quantity pure.
2. Aerated foda.
3. Glauber's salt.
4. Vitriolated tartar.
5. Saltpetre.
6. Marine salt.

†

II. EARTHY SALTS.

1. Epsom salt.
2. Magnesian nitre.

* Vitriolic acid is found in extremely small quantity, and that very seldom.

† Perhaps Borax, but it is not quite certain that this is a Mineral.

3. Mag-

3. Magnesian muriate.
4. Magnesia, or common Magnesia.
5. Gypsum.
6. Calcareous nitre.
7. Calcareous muriate.
8. Chalk.
9. Alum.

III. METALLIC SALTS.

1. Aerated iron.
2. Vitriolated iron.
3. Vitriolated copper.
4. Vitriolated zinc.
5. Arsenic.

IV. SULPHUREOUS.

1. Hepatic air.
2. Liver of sulphur.

Water is found mixed with some few substances not here enumerated, as

a. Silicious earth in very fine particles sometimes gives to water a milkiness, and

b. Argillaceous earth in such quantity as to give the water the title of saponaceous, from its feel and resemblance.

Some other substances, as bitumen and naphtha, may give Water sometimes a little character, as they flow out of the same springs upon the surface of some waters.

In this view of the substances contained in mineral waters, we see they are almost all saline,
G 2
and

and as some of them are very generally distributed through the earth, we find, unfortunately for our investigation of this subject, that mineral water generally contains several of them, sometimes many, which makes it necessary to subject portions of the same water to a variety of experiments.

Gypsum, calcarious muriate, chalk, Epsom salt, muriate of magnesia, and common magnesia, aerated iron, sea-salt, and fixed air are among the most common substances found in mineral waters.



CLASS

CLASS I.

ACID AND NEUTRAL SALTS.

Synonymous Names.

1. FIXED AIR.

{	Carbonic acid.
	Carbonaceous acid.
	Crétaceous acid.
	Mephitic acid.
	Aerial acid.
	Atmospheric acid.
	Spiritus sylvestris.
	Gas sylvestre, &c. &c.
	Gas.

This substance is found in every part of nature that we are acquainted with, in its different states; fixed as it has been called, and aeriform. In our atmosphere it is found in the proportion of about one in 100. Pits and cavities are frequently filled with it. It exists in immense quantities combined with calcareous earth, forming chalk and marble; and with many other substances. It is constantly thrown out from animals and vegetables; it is the great product of combustion, and formed in short by every process, in which pure air is combined with carbonaceous matter; hence it is no wonder that it is so general and so frequently found the uniting medium to substances contained in mineral waters. Mineral waters, which contain this alone, or considerably prevailing, have been called *Acidulæ*; and perhaps hence all mineral waters were formerly termed *Acidulæ*.

a. Fixed

a. Fixed Air is discovered in water by its sparkling, on agitation, and bubbles of air being given out from it.

b. By its pungent and acid taste.

c. Tincture of litmus added to it, is changed from its blue colour to a red.

d. On its being added to lime water, white clouds are formed. The fixed air combining with the lime forms chalk, which not being soluble, is precipitated in a fine white powder.

e. By boiling it, the fixed air is expelled, and the quantity contained in any portion of water may be measured, by conveying it through a tube into lime water, and collecting the precipitated chalk; every 30 grains of which contains 18 grains and $\frac{1}{2}$ of fixed air.

2. AERATED SODA.

Mineral Alkali combined with fixed air.

Synonymous Names.

Marine alkali.

Mineral alkali.

Fossil alkali.

Natron or natrum.

Soda.

Base of marine salt.

Effervescent soda.

Mephite of soda.

Chalk of soda.

Cretaceous soda.

2. AERATED SODA.

This

This salt is found in large quantities in Asia and Africa, and in their mineral waters, and in the waters of some parts of Germany; its crystals are commonly rhomboidal, extremely soluble in water, but when exposed to the air, fall into powder, it is detected in water by

a. Paper stained with the tincture of litmus is changed to a blue colour.

Tincture of litmus is prepared by infusing litmus, powdered, for a short time, in distilled water; with this the paper is stained.

b. Paper stained with the tincture of brazil wood loses its red, and is changed to a violet.

The tincture of Brazil wood is made in the same manner as the tincture of litmus, but hot water should here be employed.

c. Paper, stained yellow by an infusion of turmeric, is changed to a brown colour.

The infusion of turmeric should be made with hot water.

d. Upon adding a solution of corrosive sublimate mercury to this water, a white precipitate is produced; if the alkali be in large proportion, this precipitate will be an orange colour. In this instance the alkali unites with muriatic acid of the corrosive sublimate, and the mercury is precipitated.

e. Add a small quantity of Epsom salt to this water, it will dissolve, and no precipitation will be perceived, but give it a very little warmth, and immediately white flakes will be separated: here the mineral alkali combines with the vitriolic acid of the Epsom salt, and detaches the magnesia its other constituent part, which also unites
to

to the fixed air of the mineral alkali. The mineral alkali gives out fixed air enough to redissolve it in the water; but exposing it to a little heat detaches this fixed air, and the magnesia will be precipitated. This magnesia may be further dissolved again with effervescence, by adding any acid.

f. Upon adding a small quantity of sal. ammoniac, the mineral alkali will combine with the marine acid of the sal ammoniac, and detach the volatile alkali, which will fly off, and may be rendered visible by holding a paper moistened with some volatile acid over it, as the nitrous, marine, or acetous. These forming nitrous, marine, or acetous ammoniac, which becomes more visible.

g. By adding a small quantity of a solution of blue vitriol in water, a precipitate of a bright apple green colour will be occasioned by the alkali combining with the vitriolic acid of the blue vitriol, forming Glauber salt, which is soluble in the water, while the fixed air combines with the copper, which being insoluble, is precipitated.

3. GLAUBER SALTS.

Natron combined with Vitriolic Acid.

	Synonymous Names.
	{ Sal. mirabile.
	{ --- catharticus.
3. GLAUBER SALTS.	{ Soda vitriolata.
	{ Natron vitriolatūm.
	{ Sulphate of soda.

Its crystals are prisms with sixth unequal and striated sides, terminating in dihædrel summits: it has a bitter taste. When exposed to the air, the crystals

crystals fall into powder, it is very soluble in water. This is found in abundance in sea-water, and many mineral waters. It is detected by

a. A Solution of muriated ponderous * earth being added to water containing this salt, a precipitate, in the form of white clouds will immediately appear, and white precipitate will be gradually deposited. The ponderous earth leaving the marine acid, will unite with the vitriolic, and form ponderous spar, which being insoluble in water, gives this appearance when precipitated from it, of a white soft cloud, peculiar to itself: The marine acid combining with the natron, forms marine salt, which remains dissolved in the water.

b. A solution of nitre of silver † being added, the water first becomes of an opal or milky hue, and after some time acquires a redish cast, depositing at length a sediment of that colour. Here the vitriolic acid combines with the silver, forming sulphate of silver, a substance almost insoluble in water, therefore precipitated; The nitrous acid, combining with the natron, forms cubic nitre, which remains dissolved in the water.

c. A solution of lead combined with the acetous acid being added, a white precipitate will immediately be formed. The lead combines with the vitriolic acid, forming a substance insoluble in water, while the acetous

* Ponderous earth combined with marine acid.

† Silver combined with nitrous acid.

H

acid,

acid, combining with the natron, remains dissolved in the water.

d. An equal quantity of highly rectified spirit of wine being added to water containing this salt, the mixture becomes turbid, and by degrees small crystals will be formed at the bottom of the vessel; the spirits of wine combining with the water, separates it from the vitriolated tartar, which is precipitated from it in the form of small crystals.

4. VITRIOLATED TARTAR.

Kali combined with vitriolic Acid.

4. VITRIOLATED TARTAR.

Synonymous Names.

{ Arcanum duplicatum.
Sal de duobus.
Sal polychrestum.
Kali vitriolatum.
Nitrum vitriolatum.
Sulphate of potash.

It has a bitterish taste, suffers no alteration from exposure to the air; the form of its crystals varies much, according to circumstances under which they are prepared; they are mostly six sided pyramids, sometimes six sided prisms, like rock crystals: they are small compared with the foregoing.

This salt is rarely found in mineral waters.

a. By adding a solution of muriated ponderous earth to water containing this salt, the same appearances take place as described (49 a.) while the

the muriatic acid combining with the vegetable alkali, forms *sal digestivum sylvii*, which remains dissolved.

b. By the addition of the mercurial solution (c) yellowish clouds will immediately be formed, and in time a precipitate of the same colour will be deposited. The mercury, leaving the nitrous acid, unites with the vitriolic, forming turpith mineral, which is insoluble in water, though a part of the vitriolic acid and mercury remain dissolved along with nitre, formed by the nitrous acid uniting with the vegetable alkali.

c. The addition of the solution of sugar of lead in water separates a white precipitate, as mentioned page 49. c. The vitriolic acid unites with the lead, while the acetous acid combines with the vegetable alkali, forming diuretic salt, which continues dissolved.

d. By adding an equal quantity of highly rectified spirits of wine, the mixture will become turbid, and by degrees small chrystals of vitriolated tartar will be formed at the bottom, for reasons assigned page 50. d.

(c) Mercury combined with nitrous acid by the assistance of heat.

S A L T

5. SALT PETRE.

The compound of nitrous Acid with Vegetable Alkali.

Synonymous Names.

5. SALT PETRE. { Nitre.
Common nitre.
Prismatic nitre.
Nitre of potash.

This is found generally near places inhabited by animals; it is inflammable, its crystals are six-sided prisms, terminating in dihedral pyramids, or cut with a slope, and frequently channelled.

a. When found in water, it may be detected, by heating the water containing it, then adding a little vitriolic acid to it, this unites with the alkali, forming vitriolated tartar, and detaches the nitrous acid, which being volatile, may be rendered sensible, by holding any thing moistened with volatile alkali over the surface; the vapour of the volatile alkali, uniting with the vapour of the nitrous acid, forms a visible whitish smoke, consisting of the nitrous ammoniac in fine dust.

b. By adding an equal quantity of highly rectified spirits of wine to this water, it becomes turbid, and this salt is separated from it, with the appearances as described page 50. d.

c. A piece of paper moistened with it, and suffered to dry, will be found to become touch-paper.

6 COMMON

6. COMMON SALT.

A Compound of Muriatic Acid with Mineral Alkali.

6. COMMON SALT.

Synonymous Names.

{ Salt.
 { Sal gemmæ.
 { Sal marinum.
 { Gem salt.
 { Sea or marine salt.
 { Culinary or kitchen salt.
 { Muriate of soda.

This salt abounds in nature, in vast masses in the earth; dissolved in the water of the sea; and in salt lakes; and, therefore, very frequently met with. Its crystals are regular tubes; it is detected

a. By adding vitriolic acid to the water containing it, this unites with the mineral alkali of the salt, and forms Glauber's salt, which remains dissolved in the water; the muriatic acid is detached, and, being a volatile substance, may be rendered visible as the nitrous acid page 52. a. by means of the vapour of volatile alkali held over it; the volatile alkali uniting with the muriatic acid, forms sal ammoniac, which becomes visible in this very fine dust.

b. By adding a solution of nitre of silver, a white precipitate is immediately formed, which some time after will acquire a bluish appearance, and this precipitate will not be redissolved by the addition

addition of either the nitrous or acetous acids; the silver uniting with the muriatic acid of the salt, forms luna cornea, a substance scarcely at all soluble in water; the nitrous acid unites with the mineral alkali of the salt, forming cubic nitre, which remains dissolved in the water.

c. Upon adding the mercurial solution, white clouds will immediately appear, and a precipitate of the same colour will subside to the bottom.

In this instance the muriatic acid of the salt unites with the mercury, forming calomel and corrosive sublimate; the calomel being almost insoluble in water, is precipitated. The corrosive sublimate remains dissolved in the water, with the cubic nitre, formed by the nitrous acid and the mineral alkali.



CLASS II.

EARTHY SALTS.

1. EPSOM SALT.

Vitriolic Acid combined with Magnesia.

Synonymous Names.

- | | | |
|----------------|---|---|
| 1. EPSOM SALT. | { | Bitter purging salt.
Magnesian vitriol.
Salt of fedlitz.
Sulphate of magnesia. |
|----------------|---|---|

It was formerly obtained from wells in the neighbourhood of Epsom, and in the hills that run to the eastward of that place, whose waters contain it abundantly. It has a very bitter taste, is very soluble in water, and is very apt to form short needle-like crystals, when hastily crystallized; otherwise they are quadrangular prisms, terminating in quadrangular pyramids.

A. The magnesian basis may be detected

a. By the addition of lime water, to water containing this salt, which renders it turbid, and a flaky precipitate will be gradually formed. Lime has a stronger affinity to vitriolic acid than magnesia, combines with it and forms gypsum, a small portion of which remains dissolved in the water, the rest is precipitated along with the magnesia.

b. A

b. A solution of caustic vegetable alkali also renders it immediately turbid, and a white flaky precipitate is deposited. The caustic vegetable alkali uniting with the vitriolic acid, forms vitriolated tartar, which remains dissolved in the water, while magnesia being insoluble, is precipitated.

c. But if a solution of mild vegetable alkali, or vegetable alkali combined with fixed air, be made use of, there will be no precipitation; or, if the liquor should grow turbid, it will become clear again on being stirred the magnesia being redissolved by means of the fixed air that was contained in it. If the liquor be now placed in a warm situation, and this fixed air be suffered to escape, the magnesia will appear in a white precipitate.

d. By addition of the mineral or volatile alkalis, in their caustic and mild state, similar effects will be produced, as here mentioned, where vegetable alkali is used in its caustic and mild taste.

e. A solution of soap being added to water containing Epsom salt, it becomes turbid, and a number of white flakes are deposited. The alkali of the soap combines with the vitriolic acid, and forms vitriolated tartar, which remains dissolved in the water, and the unguinous part with the magnesia forming an earthy soap.

f. A solution of acid of sugar being added, no precipitation will take place, unless some calcarious earthy salt be mixed with it.

B. The nature of the acid contained may be detected

g. By

g. By adding a solution of ponderous earth in marine acid to this water, white clouds will be instantly formed, and a white precipitate be gradually deposited (described page 49. a.) The magnesia combines with the marine acid, forming muriate of magnesia, which remains dissolved in the water.

h. Or by adding a solution of nitre of silver, there will be no precipitate, but the liquor will have an opal appearance, and after sometime a reddish one, depositing at last a precipitate of this colour. The magnesia, combining with the marine acid, remains dissolved. The silver, combining with the vitriolic acid, forms this precipitate as described (page 49. b.)

i. The solution of nitre of mercury produces yellowish clouds, and by degrees a precipitate of the same colour, which is turbeth mineral (page 51. b.) The magnesia, uniting with the nitrous acid forms nitrate of magnesia, which remains dissolved in the water.

k. If a solution of sugar of lead be employed, a white precipitate, vitriol of lead, will be immediately formed by the lead uniting with the vitriolic acid. The magnesia unites with the acetous acid, and remains dissolved.

100 Grains of vitriol of lead contains 28 grains of vitriolic acid.

l. Highly rectified spirits of wine produces a turbid mixture, and by degrees small crystals of Epsom salt will be formed at the bottom of the vessel.

m. A solution of blue vitriol being employed, produces clouds of a pale green colour, and
I after

after some time a precipitate of the same colour.

2. MAGNESIAN NITRE.

Nitrous Acid combined with Magnesia.

Synonymous Names.

2. MAGNESIAN	{	Nitre of magnesia.
NITRE.		Nitrated magnesia.
		Nitrate of magnesia.

It is found in the mother water of nitre, and, like it, very rarely found in mineral waters; it has an acrid and very bitter taste; it imbibes moisture from the air.

A. a. The magnesian basis is detected by the same means, and with the same appearances, as (page 55, a.)

b. By lime water, the nitrous acid uniting with the lime, the magnesia is precipitated in a white flaky appearance. The caustic, vegetable, fossil, or volatile alkali being added, the same appearances are produced, the water becomes turbid, and white flakes appear, as described (page 56, b.) The caustic alkali, uniting with the nitrous acid, precipitates the magnesia.

c. So also, when employed in their mild state, the same appearance will take place, as described, (page 56, A. c.)

d. With the addition of soap, white flakes appear, as described above, the nitrous acid combining with the alkali of the soap, and the magnesia with the oil.

B. f.

B. e. The nature of the acid may be detected, by adding a little vitriolic acid, when the nitrous acid will be detached, as described (page 52, a. and 53, a.)

f. A solution of blue vitriol gives the same appearances as described (page 57, m.)

3. MAGNESIAN MURIATE.

Muriate Acid combined with Magnesia.

Magnesian muriate, or muriate of magnesia, exists in sea water and salt spring waters, but in a more pure state in Epsom and similar waters, is therefore very common. Magnesian muriate has a very bitter hot taste, is very soluble in water, difficult to chrystalize; its chrystals are needle shaped.

A. a. The magnesian basis may be detected in waters containing this salt, by the same means, and with the same appearances, as described (page 58, a. b. c. d.) The lime and alkalis, combining with the muriatic acid, detach the magnesia.

b. By means of a solution of soap in water, the same appearances take place, as described (page 58, d.)

B. c. The acid contained in this water may be detected by the means described (page 59, B. e.) The muriatic acid being volatile, is detached in an invisible vapour which uniting to the vapour of the volatile alkali, forms a whitish smoke, consisting of sal ammoniac.

d. By adding a little of the solution of silver in nitrous acid, white clouds will appear, acquiring

quiring in time a bluish appearance, as described (page 53, b.)

e. Or by adding a little of the solution of quicksilver in nitrous acid, white clouds will immediately appear, and the same appearances take place as described (page 53, c.)

f. Upon adding a little of the solution of blue vitriol, the precipitate of the pale green colour, above described, will appear.

4. MAGNESIA;

OR

Magnesia combined with fixed air.

Synonymous Names.

- | | | |
|--------------|---|---------------------------------------|
| 4. MAGNESIA. | { | Magnesia alba. |
| | | Common magnesia. |
| | | Mildoreffervescing magnesia. |
| | | Magnesian earth. |
| | | Aerated magnesia. |
| | | Magnesian chalk. |
| | | Muriatic earth. |
| | | Cretacious magnesia. |
| | | Mephite of magnesia. |
| | | Carbonated, or carbonate of magnesia. |
| | | Magnesian carbonate, &c. |

Magnesia is found no where pure, but, combined with other earths, it is found in abundance in nature, in a variety of forms: it is found in the mother water of nitre, and in the other states mentioned in the two preceding pages.

A. a.

A. a. The magnesia, contained in the water, may be detected by means of a solution of caustic, vegetable, or fossil alkali. The caustic alkali unites with the fixed air, is rendered mild, and remains dissolved in the water, while the magnesia is precipitated

b. By suspending a piece of reddened* litmus paper in it, it will loose the red colour given it by the vinegar, being blue again. And that this is only owing to the magnesia, will be farther proved, by evaporating the water half away, the remaining liquor will be found to possess no power of changing the colour of the reddened litmus paper, and the fixed air having escaped, the magnesia is precipitated in a white powder, and the liquor will be found to be water only.

c. If the piece of paper, that is made use of, be stained with the tincture of Brazil wood, instead of litmus, it will be changed from a red to a violet colour.

d. Or if a solution of soap be added, as mentioned (page 56, e.) The soap is decomposed, the alkali of the soap uniting with the fixed air, and the oil with the magnesia, forming an earthy soap.

B. e. The acid basis will be detected to be fixed air by evaporation, in a close vessel, as described (page 46, e.) The fixed air, as it flies off, may be forced into lime water, which it will decompose.

* First stain the paper with a little infusion of litmus, then wet it with vinegar.

GYPSUM

5. GYPSUM.

Vitriolic Acid combined with calcarious Earth.

Synonymous Names.

5. GYPSUM.	{	Vitriol of lime.
		Calcarious vitriol.
		Selenite.
		Paris plaister.
		Sulphate of lime.

This salt abounds in nature, and therefore is exceeding commonly found in spring water; but so small a quantity dissolves, that it gives very little taste to water.

a. a. In waters, containing Gypsum, the earthy basis may be detected by a piece of paper, stained with decoction of Brazil wood, being dipped into this water, will tinge it of a violet colour.

b. If a little acid of sugar be added to water containing it, the water will immediately become turbid, and a white powder be deposited. The acid of sugar has a stronger attraction to the calcarious earth than the vitriolic acid combined with it, and forms saccharine selenite, a salt extremely difficult of solution, therefore precipitated while the vitriolic acid remains diffused through the water.

c. A solution of the caustic vegetable alkali being added, produces white clouds. The calcarious earth is precipitated, in its caustic state, by the union of the alkali with its vitriolic acid,

on the water being stirred. This soon dissolves again; caustic calcarious earth or lime being soluble in water, but by exposing it to the air, or adding a little fixed air to it, it becomes chalk, and is again precipitated.

d. Or the mild vegetable alkali being employed, the precipitate will not dissolve in the water, but fall to the bottom, and will be found to possess all the properties of common areated calcarious earth, or chalk.

e. So, instead of the vegetable alkali, the fossil or volatile be employed in its caustic state, no precipitation is produced, lime being precipitated; but if the mild volatile alkali be made use of, a white powder will be precipitated, which will be found to be chalk.

f. A solution of soap being added to this water, the same appearances will take place, as when added to water containing Epsom salt. The calcarious earth uniting with the oil, and being precipitated, the vitriolic acid uniting with the vegetable alkali.

B. g. The acid element is discovered by the solution of muriated ponderous earth; upon adding this, white clouds are immediately produced, as described (page 49) and a white insoluble precipitate, which is an artificial ponderous spar, will be gradually deposited at the bottom of the vessel, as described (page 49); only here the calcarious earth remains dissolved in water in union with the marine acid.

h. Upon adding the solution of nitre of silver, nitre of mercury, sugar of lead, or blue vitriol, to waters containing Gypsum, the same appearances take place as enumerated (page 57).

CALCARIOUS

6. CALCARIOUS NITRE.

Nitrous Acid combined with calcarious Earth.

Synonymous Names.

6. CALCARIOUS NITRE. { Calcarious nitrate.
Mother water of nitre.
Nitrate of lime.

It is very rarely found in waters; it, has a bitter disagreeable taste, with something of the taste of nitre.

a. By adding the vitriolic acid to water containing this salt, and warming the liquor, a vapour will arise, which may be rendered visible, by placing a stopper, moistened with volatile alkali, over the surface of this liquid. Here the vitriolic acid, combining with the calcarious earth, forms selenite, which, if in any considerable quantity, will be precipitated and form chrystals. The nitrous acid is detached, and, being volatile, will fly off, and at that time becomes visible by the vapour of the volatile alkali, as described (page 52).

b. By the addition of the saccharine acid, the water will immediately become turbid, and a white powder will be deposited at the bottom of the vessel. The saccharine acid, in the same manner, unites with the calcarious earth, and forms calcarious selenite, which, being almost insoluble, is precipitated, while the nitrous is detached, and flies off.

c. A

c. A solution of caustic, vegetable, fossil, or volatile alkali, unites with the nitrous acid, forming nitre, which remains dissolved in the water, and precipitates the calcareous earth in the form of lime, which dissolves again in the water, and may be detected as related (page 63).

d. And a solution of mild alkali, in like manner, unites with the nitrous acid, calcareous earth being precipitated in its mild form, or chalk, as mentioned in the same page.

e. On the addition of a solution of soap, the same appearances will take place, as when it is added to water containing Epsom salt (page 56. e.)

f. A solution of blue vitriol added to water containing this salt, clouds of a pale green colour will be formed.

CALCAREOUS MURIATE.

Muriatic Acid combined with calcareous Earth.

Synonymous Names.

CALCAREOUS MURIATE.	{	Mother water of marine salt.
		Calcareous marine salt.
		Fixed sal ammoniac.
		Muriate of lime.
		Murias calcareous.

It is found wherever sea salt is met with, particularly in sea water; chalk often contains it; it has a salt and very disagreeable bitter taste. It crys-

K

talizes

talizes in prisms, with four striated faces, terminated with sharp-pointed pyramids. It deliquesces immediately on exposure to the air.

A. To water containing this salt, to detect the earthy basis,

a. Add a little solution of the acid of sugar, the mixture becomes immediately turbid; the acid of sugar, uniting with the calcareous earth, forms a compound scarcely soluble in water, which is precipitated, leaving the muriatic acid in the water, as described (page 62, b.)

b. Add a little of the solution of either of the alkalis, in a caustic state, white clouds will immediately form, the alkali uniting with the muriatic acid, the calcareous earth is precipitated; but here, on the liquor being stirred, the precipitate disappears, for the calcareous earth being in its caustic state (Lime) on being mixed with the water, dissolves in it; but if this liquor be exposed to the air, or if fixed air be thrown into it, this lime becomes chalk, which will fall to the bottom.

c. If the solutions of the alkalis be employed in their mild state, or combined with fixed air, white clouds will immediately form, as above, which will disappear again, on stirring the liquor, but on another principle, there being a double affinity; for while the alkali combines with the muriatic acid, the fixed air, which was combined with the alkali, unites with the calcareous earth, and forms chalk; but here the fixed air is detached in such abundance, as also to dissolve the chalk so formed in the water; now warm the water, the superabundant fixed

fixed air will fly off, and the chalk be precipitated.

d. By adding a solution of soap, the same appearances will take place, as in water containing Epsom salt, described (page 56, e.)

By adding a solution of silver in nitrous acid, or of mercury in nitrous acid, or of lead in acetic acid, or of blue vitriol, or by adding spirit of wine, the same appearances will be produced as upon adding these substances to water containing Epsom salts, described (page 57, h. i. k. l. m.)

B. e. The acid may be detected by the same means, and with the same appearances as described (page 53 and 54, a. b. c.)

CHALK.

Calcareous Earth combined with fixed Air.

Synonymous Names.

CHALK.

{ Creta.
Cretaceous earth, &c. or
Calcareous earth.
Calcareous spar.
Calcareous carbonate.
Carbonate of lime.
Aërated lime.

This is found in immense quantities in most parts of the earth; at least the superficial parts; of course is found dissolved in almost all spring waters.

A. a. Upon placing a bit of reddened litmus paper in water containing it, the red colour will gradually disappear and the blue return; but if a portion of the water be first evaporated, it will become turbid, the superabundant fixed air, which keeps the chalk in solution, will fly off, and the chalk be deposited: now place the litmus paper in it, and no alteration of colour will take place. The calcareous earth not being in sufficient quantity in the water to combine with the vinegar, that gives this red colour to the litmus paper.

b. Upon putting into it a piece of Brazil wood paper, the red colour will be by degrees changed to a violet; but if a portion of the water be evaporated, and the remainder be suffered to settle as above, no alteration will happen, unless the water contain also Gypsum, or some alkali.

c. On adding the acid of sugar to this water a precipitate takes place, as described (page 62. b.) it combines with the calcareous earth, and falls to the bottom, while the fixed air remains dissolved in the water.

d. A solution of soap being added to this water, the same appearances take place as described (page 56. e.) The lime and oil forming an earthy soap, while the fixed air unites to the alkali.

B. e. The fixed air contained, if in any quantity, may be discovered by the method described (page 46. d. e.) or by adding a little vitriolic acid to it before the distillation. The vitriolic acid unites with the lime, and forms Gypsum, which remains dissolved in the water, while the fixed air is detached.

A L U M.

Vitriolic Acid combined with argillaceous Earth.

Synonymous Names.

ALUM. { Argillaceous vitriol.
Aluminous sulphate.
Sulphate of alumine.

Alum has a very astringent and acid taste; its crystals are of the figure of an octohedron; it is very rarely found in mineral waters.

A. a. The earthy basis may be detected by the addition of lime water, which occasions a turbid appearance, and a flaky precipitate will be gradually formed, which is the earth of alum. The vitriolic acid, uniting with the calcareous earth of the lime water, forms Gypsum, which is more soluble in water.

b. A solution of alkali, either caustic or mild, vegetable, fossil, or volatile, added to aluminous water, produces a white flaky appearance. The alkali combines in the same manner with the vitriolic acid, and precipitates the earth of alum, either alone or combined with fixed air, leaving vitriolated tartar, Glauber's salts, or volatile ammoniac, according to the alkali made use of, dissolved in the water.

c. By adding a solution of soap, the aluminous water becomes turbid, and deposits a number of white flakes, the alkali of the soap uniting

ing with the vitriolic acid, and the unguinous part with the earth, forming an earthy soap.

B. d. The vitriolic acid may be detected by the addition of a solution of muriated ponderous earth, white clouds will be instantly formed, and a white insoluble precipitate, which is an artificial ponderous spar, will be gradually deposited at the bottom of the vessel, as related in other instances, where vitriolic acid constitutes one of the elements, (page 49, a.)

e. By adding the solution of nitre of silver, nitre of mercury, or sugar of lead, to water containing alum, the same appearances will take place as enumerated (page 49, b. page 57, h. i. k.) the aluminous earth uniting with the acids, in the same manner as the magnesia in those instances.

f. A little solution of blue vitriol being added, a green precipitate will be formed, with a small tinge of blue in it.

CLASS III.

METALLIC SUBSTANCES.

AËRATED IRON,

Iron combined with fixed Air.

Synonymous Names.

AËRATED
IRON.

{	Aperient saffron of mars.
	Rust of iron.
	Martial chalk.
	Martial mephite.
	Carbonate of iron.

Both iron and fixed air being found in almost every situation, and readily uniting together, and, especially where the fixed air is in any quantity, readily dissolving in water; it is no wonder that this is among the most common substances met with in springs. Waters containing it are called chalybeate, or ferruginous waters; and, from their strengthening medicinal qualities, are very generally used. They have somewhat of a styptic or irony taste, mixed with some pungency, from the superabundant fixed air they contain.

This water is very easily known.

A. a. In being exposed to the air, or heated, it precipitates a brown powder, which is calx of iron. The fixed air being decomposed; the water will have a rainbow-coloured pellicle on it.

(1) b.

(1) b. On adding the tincture of galls, a purple-coloured precipitate will appear, which, if in any quantity, will be almost black; but if the fixed air be first suffered to evaporate, and the iron to precipitate as above, the liquor will effect no change with the tincture of galls.

(2) c. On adding the smallest quantity of Prussian lixivium, a beautiful blue colour will be precipitated. The Prussic acid, uniting with the iron, forms Prussian blue; neither will this happen, if the precipitation a. be suffered to take place first.

d. On adding a little solution of soap, the water will become turbid, and white flakes will be precipitated to the bottom of the vessel; the alkali of the soap uniting to the fixed air, and the iron to the oil, forming a metallic soap.

e. On adding a solution of volatile liver of sulphur, a precipitate of a very dark green colour is formed. The sulphur combining with the iron, becomes insoluble in the water.

B. f. The fixed air may be detected as described (page 46, a. e.)

(1) *Tincture of galls is made by infusing powdered galls in spirits of wine.*

(2) *Prussian lixivium is formed by digesting Prussian blue with caustic vegetable alkali and water, and then adding a little distilled vinegar to neutralize any superabundant alkali, if alkali should prevail.*

VITRIOLATED IRON.

Iron combined with Vitriolic Acid

Synonymous Names.

VITRIOL- ATED IRON.	{ Sal Martis.
	{ Copperas, or green copperas.
	{ Vitriolum viride, green vitriol.
	{ Martial vitriol.
	{ Vitriol of iron.

Sulphate of iron.

Although this salt is formed from the decomposition of martial pyrites, which decompose very readily, and are extremely common; and is formed also by other natural processes; and although this salt is by no means uncommonly found solid, in it's native state, yet it is very rarely met with in mineral waters. Its chrystals are of a green colour.

It is detected nearly as the former.

A. a. By exposing it to the air it will not so soon, or so perfectly, deposite the iron in a brown precipitate as the former page 71. The vitriolic acid is not so readily decomposed; it will have the same rainbow coloured pelicle on it.

b. On adding the tincture of galls, the same purple colour will appear as described p. 72,

c. On adding the Prussian lixivium the same colour will be formed, as page 72, and that although it has been first heated.

d. On adding a solution of caustic alkali the liquor will become yellow, and, after some time,

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deposite

deposite an ochry sediment. The alkali, uniting with the vitriolic acid, deposite the iron, which unites with a portion of pure air, forming a calx of iron.

e. On adding a solution of soap, the same appearances take place as described (page 72, d.)

f. On adding a solution of liver of sulphur, a black precipitate will immediately appear: if to this black precipitate a few drops of vitriolic acid be added, it will be perfectly redissolved as before.

g. If water be added, impregnated with hepatic air, the same effect will be produced.

B. h. The nature of the acid may be more perfectly determined, by adding a solution of muriated ponderous earth, when white clouds will instantly be formed. The ponderous earth, uniting with the vitriolic acid, forms baroselenite, which is precipitated, while the iron, combining with the muriatic acid, remains dissolved in the water; for, upon adding the Prussian lixivium, or tincture of galls, the blue or purple precipitates will appear.

i. By adding a solution of nitre of mercury, a beautiful yellow precipitate will be obtained. The vitriolic acid uniting with the mercury forms turpeth mineral, while the nitrous acid, uniting with the iron, remains dissolved in the water, as may be known by adding the tincture of galls, or Prussian lixivium.

VITRIOLATED COPPER.

Copper combined with Vitriolic Acid.

Synonymous Names.

VITRIOLATED
COPPER. { Blue vitriol.
Blue copperas.
Vitriol of cyprus.
Vitriol of copper.
Vitriol of venus.
Sulphate of copper.

Its chrystals are of a beautiful blue colour, of an oblong rhomboidal shape, the taste is styptic, even caustic. This is often found in mineral waters, in the neighbourhood of copper mines.

A. a. It is detected. By adding lime water, when a pale green precipitate will appear, which, upon pouring in more lime water, is redissolved, the liquor becoming a sapphire blue.

b. By adding the caustic volatile alkali, the water also becomes of a sapphire blue colour. The volatile alkali uniting with the copper, forms cuprum ammoniacum, which will remain dissolved in the water, unless it be evaporated.

c. But if the mild volatile, mineral, or vegetable alkali be employed, green clouds will be formed, and in time a precipitate of that colour will fall to the bottom. These alkalis unite with the vitriolic acid, while the copper unites with the fixed air of the alkalis, forming what is called mountain copper, which is precipitated; but if much mild volatile alkali be added, it

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will

will redissolve the precipitate, and form cuprum ammoniacum.

d. Upon adding a solution of Epfom salt, or of nitrous or muriated magnesia, the precipitate will be of a pale green colour.

e. Upon adding a solution of nitrated or muriated calcarious earth, the precipitate will be still of a more pale green colour.

f. On adding a solution of Alum, a green precipitate will be formed, with a tinge of blue in it. In these three instances, the earths unite with the acid, and the copper is precipitated.

g. If a solution of arsenic in water be added, clouds of yellowish green colour will be formed, and a substance of the same colour will be precipitated. This is called scheel's green.

h. On adding a solution of volatile liver of sulphur, clouds of a blackish brown hue will be formed, and a precipitate of the same colour fall to the bottom;

i. Or if water, impregnated with hepatic air, be added, the same effect will take place.

k. On adding a little of the Prussian lixivium, a precipitate of a brown colour will be deposited.

B. 1. The nature of the acid may be detected by adding a solution of muriated ponderous earth, nitre of silver, and the other means mentioned (page 49, a, b. &c.)

VITRIOLATED ZINC.

Zinc combined with vitriolic Acid.

Synonymous Names.

VITRIOLATED
ZINC.

{	White vitriol.
	White copperas.
	Sal vitrioli.
	Vitriol of zinc.
	Gostard vitriol.
	Sulphate of Zinc.

This is sometimes found in waters near the mines of zinc; it has a styptic taste; its crystals are colourless, and generally tetrahedral prisms, terminating in pyramids.

a. By adding limewater pearl coloured clouds will appear, and a precipitate of this kind will fall to the bottom.

b. Vegetable alkali, mild or caustic, being added, a precipitate will appear of a dirty yellowish pearl colour.

c. Upon adding caustic volatile alkali, a pale orange coloured precipitate will be formed.

d. But if the volatile alkali be employed in its mild state, a precipitate, nearly of a white colour will be formed. These several substances unite with the vitriolic acid, and remain dissolved in the water, whilst the zinc is precipitated in the form of a calx.

e. Upon adding the Prussian lixivium, a dirty white precipitate is formed, which becomes yellow in the fire, and becomes white again, on cooling. The Prussian lixivium will not precipitate earths from solutions of earthy salts in water.

f. Liver of sulphur, or hepatic air, precipitates zinc of a pale coffee colour.

g. Most of the precipitates of zinc will be found to be volatile in the fire,

A R S E N I C.

Regulus of Arsenic combined with pure Air.

Synonymous Names.

ARSENIC.	{	White arsenic.
		Calx of arsenic.)
		Flowers of arsenic.
		Lime of arsenic.
		Oxide of arsenic.
		White oxide of arsenic.
		Sublimed white oxide of arsenic,
		Oxygenated arsenic.

Arsenic is found in spring waters in the neighbourhood of mines; and as such waters are extremely poisonous, it is important to detect it. Arsenic is very soluble in water, on evaporating the water it crystallizes into triangular pyramidal crystals of a yellowish colour.

a. If

a. If it exists in any quantity in water, it may be obtained by simple evaporation, and either crystallizing the arsenic or evaporating to dryness, and then exposing the residuum to a red heat, in which it will fly off, giving out a strong smell of garlic.

b. On adding a solution of liver of sulphur, or hepatic air, to a solution of arsenic in water, yellow clouds will be produced, and a precipitate of the same colour will fall to the bottom. The arsenic uniting with the sulphur, forms orpiment, which is precipitated.

c. A solution of blue vitriol being added, clouds of a yellowish green colour will be formed, which gradually fall to the bottom. The arsenic, uniting with the copper, forms what is called scheel's green.

d. On adding a solution of gold to water containing arsenic, the gold, after some time, will be precipitated in its metallic state.

e. Upon adding a solution of vitriolated iron, a precipitate, of a dirty green colour, will fall to the bottom. The iron combining with the arsenic.

f. Most of these precipitates also will be found volatile in heat, giving the smell of garlic as they fly off.

It has been the custom to give mucilaginous drinks to persons that had swallowed arsenic. Milk, fat, oil, butter, &c. But Navier, a Physician at Chalones, in France, recommends, from his own experience, the calcarious, or alkaline, livers of sulphur as the best means of counteracting this poison. These combine with arsenic in the humid, way saturate it, and almost divest
it

it totally of its causticity. They act still better, if impregnated with a little iron. He prescribes a drachm of these livers of sulphur dissolved in a pint of water, to be drank at various draughts, or five or six grains of them to be made into pills; drinking a glass of warm water after each dose: and he recommends the use of sulphureous waters for some time after the first symptoms are removed. He assures us, that he has seen the happiest effects of this in removing the tremors and paralytic affections, occasioned by this poison.



SECT. V.

Of the Contents of the Air.

Did not the acid vigor of the mine,
 Roll'd from so many thund'ring chimneys, tame
 The putrid steams that overswarm the sky;
 This caustic venom would perhaps corrode
 Those tender cells that draw the vital air,
 In vain with all their unctuous rills bedew'd (*d*).

THAT thin, transparent, invifible fluid, called the atmosphere, which furrounds the earth, riles to a confiderable height above its furface. Although invifible to us, it is a real fubftance, excluding other fubftances from the fpace which it occupies, and, like other fluids, preffes equally in all directions: its weight is the caufe of the fufpention of mercury in the barometer, and is to that of water as 1 to 900, or 15 pounds upon every fquare inch of the earth.

It chiefly confifts of two elastic fluids, or gafes(*e*), poffeffed of very different and oppofite properties; it contains alfo other gafes, or fubftances, fufpended or diffolved in it, but in fmall quantity. Thefe two fluids, or gafes, are diftin-

(*d*) Armstrong's Art of preferving Health, p. 51.

(*e*) Gas, from gascht (German) an eruption of wind; any matter fubtilized by heat into an elastic aeriform ftate.

M

guifhed

guished by the names of oxygen gas, or the pure part of the atmosphere, first discovered by Dr. Priestley in the year 1774, and by him called dephlogisticated air; by others vital air, because it is the only air that is capable of sustaining the vital principle, or of supporting the combustion of inflammable matter: it is not only the sole vivifying power, but the parent of acidity, and hence named oxygen (*f*), from the most general property which its base possesses of forming acids, by combining with different substances.

The other, or noxious portion of the atmosphere, is termed azote (*g*), from its known quality of killing animals; hence the noxious part of the atmospheric air, which is totally unfit for respiration, is called azotic gas, or phlogisticated air.

The atmosphere contains other elastic fluids analogous to common air, with respect to elasticity and invisibility; but otherwise essentially different from each other; such as fixed air, or carbonic acid gas; inflammable air, or hydrogen gas; nitrous gas: besides a variety of other substances, resulting from various exhalations constantly emitted from vegetable, animal, and fossil bodies (*h*); but it is to the gases above enumerated that the following observations will be confined.

Atmospherical

(*f*) Oxygen, οξύς, acidum, or acid, and γινωσκω, gignor, to produce, or generate acids.

(*g*) Azotum, αζωτον, from a privation of, and ζωω, life.

(*h*) *Fluoric acid gas*, which is disengaged from native fluete of lime, or vitreous spar, by sulphuric acid. *Muriatic acid gas*, or muriatic acid purified from water, and melted by caloric into an elastic

Atmospherical Air, or common Air.

As the two gases of oxygen and azote exist in the air, merely in a state of intimate mixture, and not in chemical combination, they may be easily separated by a substance possessing an electric attraction for either of them: thus, if pure mercury be exposed for some time in closed vessels filled with atmospheric air, to a heat nearly approaching to ebullition, a quantity of air will disappear, and the mercury be converted into a red powder, oxyd, or calx of mercury, which will have gained an addition of weight equal to that of the air absorbed, the mercury having united with the oxygen gas, which leaves the azote. If a bell glass be inverted over a solution of liver of sulphur, the air in it will suffer a diminution; the oxygen will be absorbed, and the unabsorbed part will be azote, showing that there are 27 parts of oxygen, and 73 parts of azote in 100 parts of atmospheric air.

If the azote in liver of sulphur be expelled, and the oxygen in the red calx of mercury, or

elastic fluid. *Oxygenated muriatic acid gas*, or *dephlogisticated marine acid*, which is disengaged during the reciprocal action of native oxyd of manganese and muriatic acid, being produced by the transition of oxygen from the manganese into the muriatic acid. *Ammoniac gas*, *alkaline air*, or *volatile alkaline gas*, is disengaged by heat from liquid ammoniac; or, from a mixture of ammoniacal muriate, or common sal ammoniac, with quick lime. *Hepatic gas*, or sulphurated hydrogenous gas, is obtained from solid alkaline sulphures, or livers of sulphur, by decomposing them with acids. *Phosphorated hydrogenous gas*, or *phosphoric gas*, obtained by boiling a lixivium of caustic pot-ash with half its weight of phosphorus, and receiving the elastic fluid disengaged into glasses containing mercury.

M 2

precipitate

precipitate per se, and these be mixed, atmospheric or vital air will be formed.

OXYGEN GAS constitutes about one fourth of the atmosphere, and is composed of light, caloric (*i*), and oxygen. It is procured, by filling a receiver with the green leaves of vegetables, and inverting it in spring water, and exposing it to the direct rays of the sun; the leaves yield a considerable quantity of oxygen air, which ascends to the upper part of the receiver, and may be easily removed from it for use. It is produced from various other substances, and particularly from nitre, or the metallic calces. One ounce of nitre, exposed to a red, or rather white heat, in an earthen retort for about four or five hours, will give about 700 cubic inches of oxygen air; as this gas contains a quantity of nitrous acid in the form of vapour, it may be separated from it by agitating the air in lime water.

But it is from manganese that the greatest quantity of this gas may be procured, and it is now the substance generally used. One ounce of good manganese will, in a red heat, yield more than two pints and a half, or about 80 cubic inches of elastic fluid, one tenth of which is carbonic acid, and the rest oxygen gas.

(*i*) Caloric, latent heat, fixed heat, or principle of heat, is only known by its effects; invisible, imponderable, subtle, pervading all bodies, insinuating itself between their particles. It melts solid bodies, rarefies fluids, and renders them invisible. There are but three species of the undecompounded bodies, which are known to be rendered into the state of gas by caloric; namely, oxygen, hydrogen, and nitrogen.

Synonymous Names.

AZOTIC GAS, {
 { Vitiated air.
 { Impure air.
 { Phlogistigated air.
 { Phlogistigated gas.
 { Atmospheric mephitis.

Is composed of caloric, or heat, and a particular base, capable of becoming solid, called azote. This substance, united to different bases, forms alkalies, and may be considered as a real alkalizer, or alkalizing principle, in opposition to oxygen, which is the principle of acidity. The atmosphere, therefore, is an immense reservoir of the principles of acidity and alkalescency, without being itself either acid or alkali.

Azotic gas may be obtained by exposing certain substances to atmospheric air, which absorb its oxygen; as ammonia, or the volatile alkali, which is composed of azote, united with hydrogen.

Synonymous Names.

CARBONIC
 ACID GAS, {
 { Fixed air.
 { Solid air of Hali.
 { Cretaceous acid gas.
 { Mephitic gas.
 { Aerial acid.

Is the heaviest of the aerial fluids, being composed of carbon or charcoal, and vital air or oxygen, forming carbonic acid. It is combined with calcareous

careous earth or lime, to which it has a greater affinity than to any other; it constitutes nearly half the weight of chalk, limestone, or carbonate of lime, &c. converting them into saline substances, or carbonates; it is produced by burning limestone, in which the carbonic acid combines with caloric, and flies off in the form of gas, leaving the calcareous earth pure, or in a state of quicklime; it is produced plentifully by fermenting liquors, and is often found in coal mines, called the chalk, or chalk damp: it is formed in caverns, as in the Grotto del Cano, which extinguishes flame and destroys life. Charcoal, on burning, unites with the oxygen of the atmosphere, and forms carbonic acid, which is also destructive to life, and extinguishes the light of a candle.

Water absorbs more than its bulk of this gas, and acquires an acid taste and sparkling appearance, and most mineral waters owe their sparkling spirituous taste to this gas; and cyder, beer, and other fermented liquors owe their brightness to the carbonic acid which they contain. Water thus impregnated is capable of dissolving a small quantity of iron, forming a chalybeate water like Spa, or Pyrmont. When fixed alkali is previously dissolved in water, it will then absorb a greater quantity of carbonic acid than common water, and forms the aqua mephitica alcalina. Limestone, or carbonat of lime, cannot be dissolved but in a very small quantity in water; but pure, or quicklime, can be dissolved in a considerably greater proportion, forming lime-water, which is a test of carbonic acid; for it is certainly precipitated

precipitated by that acid in the form of carbonate of lime, or limestone. If the water be saturated with carbonic acid, it will dissolve carbonate of lime in considerable quantity; and if this solution be let fall drop by drop on any substance, or the carbonic acid escapes, the carbonate of lime will be deposited in the incrustated substance with calcareous earth, and the substance is said to be petrified.

HYDROGEN^(k) GAS,

OR

INFLAMMABLE AIR,

Inflammable Gas, or Phlogiston of Kirwan.

Hydrogen, which is the base of water, combined with caloric, forms hydrogen gas, or inflammable air, discovered by Mr. Cavendish in 1767. It is the lightest of elastic fluids, being twelve times lighter than common air; hence employed in air-balloons. It inflames by contact of an ignited body, but will burn only in contact with common, or oxygen, air. It is less noxious than the carbonic acid: suffers no diminution on mixture with nitrous air. It is produced during the dissolution of animal and vegetable bodies; hence it

(k) Hydrogenium (*υδρογενιον*, from *υδωρ*, water, and *γενωμαι*, to become, or *γενναω*, to produce) hydrogen, one of the principles of water. The base of that elastic fluid, which was formerly called inflammable air.

is

is found to come out of ponds, burying-grounds, and other places containing animal and vegetable matter in a state of decay. Found also in the earth where inflammable minerals are contained; when, combining with atmospheric air, it sometimes suddenly takes fire to the danger of the miners, and by them called fire-damps. It is obtained from most kind of bodies; but the greatest quantity may be extracted from zinc, by means of diluted vitriolic acid; and from red hot iron, by passing the steam of boiling water over its surface. In like manner charcoal yields inflammable gas, called hydrocarbonate, combined with the carbonic acid gas. It is this aeriform fluid which floats frequently on marshes, and being set on fire by electricity, or other means, gives rise to the ignis fatuus. Hydrogen gas has the property of dissolving and suspending a variety of substances, as iron, charcoal, sulphur, phosphorus, &c. hence we have the names of phosphoric hydrogen gas, or phosphuret of hydrogen; sulphuric hydrogen gas, or sulphuret of hydrogen; with phosphorus it is called phosphorated hydrogen gas, giving out a fœtid smell, is improper for respiration, and takes fire spontaneously in coming in contact with the air, accompanied with an explosion; and probably to the disengagement of gas, the ignis fatuus, playing about burying-grounds and places where animals are putrifying, may be attributed.

NITROUS ACID GAS is disengaged from nitric acid by various combustible bodies, especially metals, oils, mucillages, and alcohol. By the action of the nitric acid on these substances it becomes

comes nitrous gas; it extinguishes light and destroys animals, being totally unfit for animal respiration and combustion. It is not dissolved in water, nor does it indicate the least property of an acid: by combination with vital air it affords nitric acid, being itself nothing but nitric acid deprived of a part of its oxygen, and consequently a compound of azote, or nitrogen and oxygen, containing, however, more azote and less oxygen than the nitric acid; hence are produced the varieties of this gas, according to the different proportions of azote and vital air. In nitrous gas the azote and oxygen are deprived of all that quantity of caloric and light which they possessed in the atmosphere: the oxygen, however, still retains enough of both these principles to occasion a combustion, with flame, of several combustible bodies when immersed in it, as a pyrophorus, or a small portion of sulphuret of alkali; the nitrous gas is then gradually diminished, and at length pure nitrogen gas remains. In this case, the oxygen of the nitrous gas combines with the inflammable body, and thus the nitrogen gas is left in a free state; hence, as has been intimated, it is evident that azote, or nitrogen, constitutes the basis of nitric acid, which obtains its acid property from its combination with oxygen. The mixture of one part of nitrous gas, and four parts of oxygen gas, produces red vapours; because the bases of each gas mutually combine, and form nitrous acid gas; and the superabundant caloric escapes in the state of sensible heat. If this operation be instituted over mercury, the nitric acid recently formed will remain upon its surface, in the form

N

of

of nitrous acid gas; but if made over water, it is immediately absorbed by it.

As azotic gas does not combine with nitrous gas, but remains behind when mixed with it, Dr. Priestley employed nitrous gas for ascertaining the proportionate quantity of oxygen gas in atmospheric air. To this end equal parts of nitrous gas and atmospheric air are mixed over water, and the greater or less diminution of volume of gases determines the relative quality of the air examined.

To ascertain the purity of atmospheric or other airs, different kinds of eudiometers have been described by Priestley, Magellan, and Abba Fontana. A simple method is described by Dr. Archer, which is, to have a tube, between two and three feet in length, one third of an inch wide, and open at one end, a measure for the airs; a scale carefully graduated, according to the contents of the measure, into tenths and hundredth parts, so that one of the hundredth parts will be about one-sixth of an inch. The operator is to fill the tube with water, and invert it in a trough of the same fluid, and set it over a hole on the shelf of a trough; the tube will remain perfectly full of water, from the pressure of the atmosphere upon the surface of the water in the trough. Then fill the air measure with water also, and if it be the air of the place to be tried, it is only necessary to pour out the water, and the air will occupy the same space in the measure as had before been occupied by the water. Then convey the air, contained in the measure, under the surface of the water in the trough, to the bottom of the tube; by gently turning

turning the hand, the air in the measure may be made to ascend into the tube, within which it will cause a portion of the water to descend, exactly corresponding to the quantity of air that was contained in the measure. Now mark the space which the air occupies, by applying the graduated scale to the outside of the tube; next take the same measure full of nitrous air, and introduce it also in the same manner into the tube; gently agitate the tube, and, after waiting some little time, apply the scale again, and observe what diminution has taken place; for if two measures of the same air had been introduced, they would occupy of course twice as much space within the tube as one would have done. But this will by no means be the case in the instance before us; for a measure of common air, and one of nitrous air, will not occupy as much space as two measures of common air, or two of nitrous would, but will fall considerably short of it; and it is in proportion to this diminution that the purity of the air is ascertained, the greater diminution denoting the greater purity of the air. Thus, if one measure of nitrous air be added to one of any other kind of air, and the diminution be $1\frac{2}{100}$, the measure of the test will be 1.26. The nitrous acid being composed of nitrous air and oxygen air, whenever these two airs meet, they put off their aëriform state, and become liquid nitrous air; which, as it mixes with the water, no longer impedes the ascent of that fluid in the tube.

The specific gravity of different kinds of air :

A cubic inch of atmospheric air weighs 385.

dephlogisticated - 420.

phlogisticated - 377.

fixed - 570.

inflammable - 35.

nitrous - 399.

SECT VI.

*Directions for collecting and distinguishing
Fossil substances, including Salts, Earths,
Metals, and Inflammables.*

TO write particularly upon these objects of natural history is not the present design, but to give such general instructions, as may assist a traveller, in the choice of fossil bodies, till fuller information can be procured, which the numerous modern authors on these subjects afford. In the arrangement adopted, I have principally had in view that by Dr. Babington; and his own and the other references annexed to the descriptive histories, will point out the principal writers on the subjects of discussion.

The traveller should be furnished with flint and steel, and the mineral acids; at least with the nitrous, and volatile acids; a hammer also will be necessary, to break bodies too bulky to bring away.

A blow-pipe is likewise an useful article; by blowing long and forcibly through such an instrument, upon the flame of a candle, by which the point of the flame may be directed against the body to be examined, it will frequently discover whether it is a calcareous, vitrifiable, or refractory substance; and for greater precision, experiments

ments for the same end may be afterwards made at the fire-side, on a charcoal fire. Even a tobacco-pipe may be used as a crucible in a common fire.

The collector should also attend to as many of the following particulars as possible.

1. When any article is collected, mark it by a number, or some sign of distinction, referring to a catalogue, with all the particulars that may be known relative to it; as,

2. Where it was found.

3. In what quantity, whether scarce or abundant.

4. If on the surface of the earth, or at what depth.

5. In what position, whether horizontal, perpendicular, &c. And with what other fossil bodies it was found; as clay, stone, slate, mineral, &c.

6. Whether in strata, or loose nodules.

7. The depth and thickness of the strata, how they incline, or to what points of the compass they tend; or if level or horizontal; whether they have perpendicular or horizontal fissures, and what fossil bodies are contained in these fissures.

8. All high mountains and hills, especially their sides, are to be searched; the shores also of the sea, with their banks, and the cliffs adjacent, and the falls of cascades, rivers, and great gullies.

9. The situation of mines, pits, and quarries, whether in a valley or hill; and the disposition of the strata, whether horizontal, inclining, &c. their thickness, and the depth they lie; and what other fossils are imbedded in the strata, or in the neighbouring caverns, fissures, partings, &c.

10. The

10. The waters of mines should be examined, whether pure, tasteless, purgative, vitriolic, or chalybeate, &c.

11. The damps and steams of mines, and what are the consequences or effects of them; in what seasons and state of the air they are chiefly observed; and what temperature the air bears in different depths of such mines.

12. The account given by the natives, inhabitants, miners, workmen, &c. who may be acquainted with the subject.

CLASS

CLASS I.

SALTS.

1. SIMPLE SALTS,

Having radicals, which are simple and known.

A. *ACID*. All acids resemble one another in taste; in their manner of giving a red colour to vegetable substances; in their common tendency to combine with earths, alkalis, and metallic oxyds.

Synonymous Names.

	{ Gas sylvestre.
	{ Spiritus sylvestris.
	{ Fixed air.
a. <i>Carbonic.</i>	{ Aërial acid.
	{ Atmospheric acid.
	{ Mephitic acid.
	{ Cretaceous acid.
	{ Carbonaceous acid.

See Sect. V. page 45, 85.

Anal. Carbon. 17. Oxygen 83. *Chaptal.*

Synonymous Names.

	{ Volatile narcotic salt of vitriol.
	{ Sedative salt.
b. <i>Boracic.</i>	{ Acid of borax.
	{ Boracine acid.

This

This acid is dry, crystallized in hexahædral plates, almost insipid, scarcely soluble, fusible with filices into a glass, very feeble in its affinities, and liable to yield up the terrene and alkaline bases to almost any other acid.

Synonymous Names.

c. Sulphuric.	{	Acid of sulphur.
		Vitriolic acid.
		Oil of vitriol.
		Spirit of vitriol.
Sulphureous.	{	Sulphureous acid.
		Volatile sulphureous acid.
		Phlogisticated vitriolic acid.
		Spirit of sulphur.

The *sulphuric acid* is formed from sulphur and oxygen, by the combustion of the sulphur; inodorate, twice as heavy as water, and less volatile, very caustic; affording sulphureous acid gas and sulphur, by its decomposition with *red hot coal*, metals, &c. forming sulphates⁽¹⁾ with the earths, alkalis, and metallic oxydes.

Anal. Sulph. 72. Oxygen 28. *Berthollet.*

Sulphureous acid is highly odorate, volatile, gaseous, destructive to blue vegetable colours, and fit to cleanse away spots made with these colours on a white ground; absorbing, by slow degrees, the oxygen from the air, and from various

⁽¹⁾ Salts formed by the combination of the sulphuric acid with different bases, decomposable by charcoal, &c. into sulphures.

acids and oxydes; forming sulphites (*m*) with the earthy and alkaline bases.

2. COMPOUND SALTS.

A. *Base POT-ASH, or Vegetable, caustic, fixed alkali.* The impure salt, containing alkali, which is obtained by evaporating the aqueous solution of wood ashes to dryness; it is then solid, white, crystallized in rhomboidal plates.

Synonymous Names.

a. *Carbonate**
of Pot-ash, or
pot-ash combin-
ed with carbonic
acid;

Fixed salt of tartar.
Vegetable fixed alkali.
Aërated vegetable fixed alkali.
Cretaceous tartar.
Mephitic tartar.
Mephite of Pot-ash.
Nitre fixed by itself.
Alkahest of Van Helmont.

It forms regular crystals, which represent tetrahædral prisms, terminating in short tetrahædral points; has an urinous taste, and changes the syrup of violets green.—*Anal.* Acid 23. Alkali 70. Water 5. *Bergman.*

(*m*) Salts formed by the combination of the sulphureous acid with different bases, and yield by the contact of almost any acid, the smell of burning sulphur with effervescence.

* A salt formed by the union of carbonic acid with different bases.

b. *Muriate*

b. *Muriate** of Pot-ash, or Febrifuge salt of Sylvius; composed of muriatic acid and pot-ash; is found in its native state in sea-water; in the mother earth of nitre manufactories; in various salt-springs; has rhomboidal or octahædral crystals.—*Anal.* Acid 31. Alkali 60. Water 8. *Bergman.*

c. *Nitrate†* of Pot-ash, Nitre, or Saltpetre; formed by the combination of nitric acid and pot-ash. It is found in the fissures of lime-stone kilns, near Molfetta, in the kingdom of Naples; in various waters, and even in rain; and in the fresh juices of many plants.—*Anal.* Acid 33. Alkali 49. Water 18. *Bergman.*

Synonymous Names.

d. <i>Sulphate†</i> of Pot-ash,	{	Vitriol of pot-ash.
	{	Sal de duolus.
	{	Vitriolated tartar.
	{	Arcanum duplicatum.
	{	Sal polychrest of Glafer.

composed of the sulphuric acid and pot-ash: scarcely ever found native.—*Anal.* Acid 40. Alkali 52. Water 8. *Bergman.*

* Salts formed by the union of the muriatic acid with different bases.

† Salts formed by the combination of the nitric acid with different bases.

‡ Salts formed by the combination of the sulphuric acid with different bases.

B. Base SODA. Caustic soda, marine alkali, or mineral alkali united to carbonic acid, which is obtained from the ashes of the kali spinosum, and of many sea plants.

Synonymous Names.

- | | | |
|--------------------------|---|---|
| a. Carbonate
of Soda, | { | Natrum or natron.
Base of marine salt.
Marine or mineral alkali.
Crystals of soda.
Cretaceous soda.
Aërated soda.
Effervescent soda.
Mephite of soda.
Aërated mineral fixed alkali.
Effervescent mineral fixed alkali.
Chalk of soda. |
|--------------------------|---|---|

is a perfect neutral salt, consisting of the carbonic acid, and pure or caustic soda; has rhomboidal crystals. Found in Hungary, Egypt, Persia, the East Indies, and China; is found ready formed on the surface of the earth.—*Anal.* Acid 16. Alkali 20. Water 47. *Delamethrie.*

b. *Borate* of Soda.* Greyish and greenish white, mostly in tabular, six-sided prisms. Found on the snow mountains of Tibet, &c.—*Anal.* Acid. 34. Alkali 17. Water 47. *Delamethrie.*

c. *Muriate of Soda,* or marine salt, or culinary salt. Crystallized in cubes, amorphous,

* Borax Tinkal.

fibrous

fibrous, compact. *Anal.* Acid 52. Alkali 42. Water 6. *Bergman.*

d. *Sulphate of Soda.* Glauber salt, or vitriol of soda. Sulphuric acid with soda.—*Anal.* Acid 27. Alkali 15. Water 58. *Bergman.*

c. *Nitrate of Soda.* Cubic nitre, or rhomboidal nitre formed by the combination of the nitric acid and soda.

Synonymous Names.

- | | | |
|------------------------|---|----------------------------------|
| C. <i>Base, AM-</i> | { | Cautic volatile alkali. |
| MONIAC, | | Fluor volatile alkali. |
| | | Volatile spirit of sal ammoniac. |
| a. <i>Carbonate of</i> | { | Ammoniacal chalk. |
| <i>Ammoniac,</i> | | Cretaceous ammoniacal salt. |
| | | Concrete volatile alkali. |
| | | Ammoniacal mephite. |
| | | English sal volatile. |

Sal ammonia united to carbonic acid.—*Anal.* Acid 45. Alkali 43. Water 12. *Bergman.*

b. *Muriate of Ammoniac,* salmiac, sal ammoniac, or muriated ammoniac, composed of the muriatic acid and ammoniac, or the volatile alkali. It is found ready formed near the craters of volcanos, and in Tartary. In Egypt it is prepared in great abundance by subliming the soot, obtained from the combustion of animal excrements.—*Anal.* Acid 52. Alkali 40. Water 8. *Delamethrie.*

c *Nitrate*

c. *Nitrate of Ammoniac*; ammoniacal nitrous salt, or ammoniacal nitre; a combination of the nitric acid and ammoniac. It is generated spontaneously in the mother earth, or saltpetre manufactories, though but in small quantities; mixed with nitrate of pot-ash.—*Anal.* Acid 46. Alkali 40. Water 14. *Delamethrie.*

d. *Sulphate of Ammoniac*; ammoniacal vitriolic salt, ammoniacal salt (secret of Glauber's) or ammoniacal vitriol, formed by the sulphuric acid and ammoniac; concrete.—*Anal.* Acid 42. Alkali 40. Water 18. *Delamethrie.*

CLASS

CLASS II.

E A R T H S.

EARTHS are such bodies as are inodorous, insipid, pulverulent or friable, not flammable, scarcely soluble in water, unchangeable in the fire; when heated, either by themselves or with inflammable bodies, do not acquire metallic splendour.

I. HOMOGENEOUS OR SIMPLE EARTHS.

Those earths which have not hitherto been decomposed, are termed elementary, homogeneous or simple earths. Of this kind are the following nine. A. Lime or calcareous earth. B. Stranthian earth. C. Baryte or ponderous earth. D. Magnesia or earth of bitter salt. E. Alumine or argillaceous earth. F. Silex or siliceous earth. G. Adamantine earth. H. Jargon earth. I. Sidnean earth; this last, however, is doubtful as an elementary earth.

A. L I M E.

a. *Pure lime*, caustic or pure calcareous earth, in a state of mixture with aërated calcareous earth, has hitherto been found only at Bath, and near the craters of some ancient volcanos.

b. *Carbonate*

Synonymous Names.

b. Carbonate of Lime,	Chalk.
	Limestone.
	Calcareous mephite.
	Aërated calcareous earth.
	Effervescent calcareous earth.
	Calcareous spar.
	Cream of lime.
	Calcareous carbonate.

effervesces with acids, convertible into pure, or quick-lime, by calcination; is then soluble in 680 times it's weight of water, forming lime-water, in which action it gives out it's latent heat, causing the mass to become hot.—*Anal.* Carbonic Acid 34. Lime 55. Water 11. *Bergman.* Here may be included stalactites, marble, limestone, chalk, zufa, ganik.

c. *Swine-stone*, carbonated lime impregnated with petroleum; colour, Isabella yellow, bluish, or blackish, or yellowish grey, is opaque, compact, and partly of a glittering appearance; when broken, exhibits a splintery or conchoidal appearance; when pounded or scraped, it emits an urinous or alliaceous smell. *Anal.* Carbonate of lime impregnated by petroleum. *Kirwan.*

d. *Sidero-Calcite*, pearl spar: colour of a white greyish, yellowish, or reddish white; found amorphous, cellular, rounded, but mostly crystallized; externally metallic or pearly; effervesces with acids. *Anal.* Carbonated lime 60. Oxyde of magnesia, 35. Iron 5. *Woulfe.*

e. *Baryto-*

e. *Baryto-calcite*, of a dark, or light grey, almost white; rounded form, or crystallized in quadrangular prisms; effervesces with acids. *Anal.* Carbonated lime 92. Carbonated baryte 8. *Bergman*.

f. *Muri-calcite*, Compound spar, of an olive colour, clayey appearance; stony, amorphous,* and crystallized. *Anal.* Carbonated lime 52. Carbonated magnesia 45. Iron and manganese 3. *Klaproth*.

g. *Argentine*, Scheifer spar, amorphous, foliated. *Anal.* Carbonated lime, with magnesia, argill, and iron. *Kirwan*.

h. *Supersaturated with carbonic acid*, Dolomite, or elastic marble, pure or greyish white, yellowish white, or light red; surface rough and uneven; fracture conchoidal or granularly foliated. Effervesces slowly with acids; phosphoresces when struck in the dark, or when laid on red-hot iron. *Anal.* Lime 44, 29. Carbonic acid 46, 1. Argill 5, 86. Magnesia 1, 4. Iron 0, 074. *Saussure, jun.*

Synonymous Names.

i. *Fluatet of lime*, { Fluor spar.
Vitreous spar.
Cubic spar.
Phosphoric spar.
Sparry fluor.

Nearly insoluble in water, does not effervesce with acids, nor strike fire with steel; is more or less transparent, and exhibits various colours; it's

* Amorphous, ex a priv. et *μορφη*, form.

† A salt formed by the combination of the fluoric acid with different bases.

surface, when scratched with a knife, appears greasy; it generally crackles and phosphorates by heat, except the colourless, which becomes electric when rubbed; and the coloured kinds lose their colour by heat; but by a strong heat is melted. *Anal.* Fluor acid 16. Lime 57. Water 27. *Scheele.* Oxyde of manganese 3. Oxyde of iron 1. Pot-ash 18. *Vauquelin.*

Synonymous Names.

k. *Phosphate of lime.* { Earth of bones.
Calcareous phosphate.
Animal earth.

Apatite, colour various, olive green, bluish, yellowish and chocolate brown; found crystallized in three and six-sided prisms; in six and eight-sided plates, variously modified, shining and of a greasy lustre, texture laminated, semi-transparent. *Anal.* Phosphoric acid; lime 55. *Klaproth.*

Synonymous Names.

l. *Sulphate of lime,* { Vitriol of lime.
Calcareous vitriol,
Selenite.
Gypsum.
Plaster of Paris.

does not effervesce with acids; found in most parts of the earth and in water; soluble in about 500 times it's weight of water; it resembles the calcareous spar, and is found in solid masses, of particular form, crystallized into hexagonal* prisms, terminating in an edge, or in rhomboids, or cuneiform, tabular or lenticular; texture fi-

* Hexagonal, ex 12, sex; et γωνία, angulus.

brous, or laminated. *Anal.* Sulphuric acid 16.
Lime 57. Water 27. *Scheele.*

B. *STRONTIAN*, or Scottish earth, so called from Strontian in Scotland; never found pure. Sulphate of Strontian is said to have been found in great quantities in the neighbourhood of Bristol. At Ham-green also, a variety of this rare production is found breaking through the soil, in such large masses, that it has been made use of in mending the roads.

a. *Carbonate of Strontian, strontianite*; hitherto found in a mild state united to fixed air; in solid masses, of a fibrous texture, striated. Like limestone, it loses its air in a strong heat, and then forms a lime, heavier than common lime, and more soluble in water. This lime-water has the singular property of affording, when saturated, compressed rhomboidal crystals, which are nothing but pure lime. *Anal.* Carbonic acid 26, 5. Strontian 73,5. *Kirwan.*

C. *BARYTE*, Ponderous earth; never found in a separate or pure state, but with the sulphuric acid, in the state of ponderous spar or sulphate of baryte; or with the carbonic acid, carbonate of baryte, or mixed with other earths.

Synonymous Names.

a Carbonate of	{	Barotic or ponderous chalk.
Baryte,		Aërated ponderous earth.
		Effervescent barotes.
		Barotic mephite.
		Barolite.

P 2

found

found in solid masses, and crystallized, hexagonal prisms, terminating in six-sided pyramids; texture shining, radiated, fibrous; brittle and semi-transparent; effervesces with diluted nitric and muriatic acids, and is entirely dissolved by them. Exposed to a strong heat, it parts with it's carbonic acid, and combines with heat, and like lime is soluble in water. *Anal.* Acid 20,8. Baryte 78,6. *Withering.*

Synonymous Names.

b. *Sulphate of Baryte,* { Heavy or ponderous spar.
Barotic vitriol.
Baroselite,

found in solid masses, crystallized, approaching to an earthy state, and the transparent kind is electric; is four times heavier than water. When exposed to heat, and to the sun, it has the property of absorbing light, which it emits in the dark. Like metals, it is precipitated from it's combinations with the different acids, by the prussiate of pot-ash*. *Anal.* Sulphuric acid 32,8. Baryte 67,2. *Withering.*

Bolognian Stone. *Anal.* Sulphate of baryte 62. Silix 16. Argill 15. Sulphate of lime 6. Water 2. *Arvidson.*

c. *Liver-stone,* of a greyish, or greyish black colour; texture foliated, striated; does not effervesce with acids; when heated, or rubbed, it

* Salts formed by the union of the Prussic acid, or colouring matter of Prussian blue, with different bases.

emits

emits a smell of liver of sulphur. *Anal.* Sulphate of baryte 38. Silix 33. Sulphate of argill 22. Sulphate of lime 7. Petroleum 3. *Bergman.*

D. *MAGNESIA* is never found naturally pure, but generally combined with the sulphuric acid, in the form of Epsom salt, sal amarus, or sulphate of magnesia.

a. *Calci-murite*, amorphous, earthy; colour blue or olive green; of the consistence of clay. *Anal.* Silix 50. With carbonate of magnesia and iron.

b. *Argillo-murite*, of a loose earthy texture; greenish yellow colour, consistence earthy. *Anal.* Magnesia, 13. Silix 50. Argill 10. Lime 3. Oxide of iron 0.9. Water 13. *Kirwan.*

c. *Silici-murite*, Martial muriatic spar, amorphous, foliated. *Anal.* Silix 50. With carbonate of magnesia and iron. *Kirwan.*

d. *Talc*, Talcite, Venetian talc, or Shiftose talc. Generally of a greenish or silvery white lustre, like mother of pearl, soft and semi-transparent; texture laminated, foliated, and greasy, or of a soapy feel to the touch; does not effervesce with acids. *Anal.* Magnesia 44. Silix 50. Argill 6.

e. *Lapis Ollaris*, Pot-stone, or Indurated talc; of a pale yellowish and greenish grey, reddish grey, or white colour, with micaceous particles; found
in

in amorphous masses, of a lamellated texture; feels greasy, does not adhere to the tongue; becomes hard in the fire. *Anal.* Magnesia 38. Silex 38. Argill 7. Iron 5. Carbonate of lime 1. And a trace of fluoric acid. *Weigleb.*

f. *Steatites*, Fatty stone, of a greyish, yellowish, or greenish white, with a shade of green colour; found in amorphous masses, of an earthy, splintery texture, lamellated; the thin lamina semi-transparent; soapy to the touch, does not adhere to the tongue. *Anal.* Magnesia, 20,84. Silex 48,42. Argill 14. Iron 1. Air and Water 16. *Klaproth.*

g. *Serpentine*, of a deep, blackish, olive green, seldom yellow, sometimes crimson red, bluish and greenish grey; generally exhibits various colours, like the skin of a serpent; found in solid masses; when broken has a dull appearance, smooth to the touch, and takes a polish. *Anal.* Magnesia 35. Silex 45. Magnetic iron 14. Carbonate of lime 6,25. Argill 0,25. *Knock.*

h. *Chlorite*, of a light and dark greenish colour, or greenish brown; of a scaly texture and glittering appearance; feels greasy or earthy; gives an earthy smell, when breathed on. It melts into a dark, black, compact slag, and thus becomes magnetic. *Anal.* Magnesia 0,39,47. Silex 0,415. Argill 0,0613. Lime 0,015. Iron 0,1015. Air and water, 0,015. *Hoepfner.*

i. *Asbestos*,

i. *Asbestos*, of a leek or olive green colour, or grey; feels greasy; breaks into parallel, striated, and sometimes curved, fibres or splinters; does not effervesce with acids. *Anal.* Carbonate of magnesia 16. Silix 63,9. Carbonate of lime 12,8. Argill 1,1. Oxyde of iron 6. *Bergman.*

k. *Amianthus*, of a green or greyish, or silvery, white, sometimes olive green; breaks into flexible, and mostly parallel, filaments; soft and greasy, somewhat transparent. *Anal.* Carbonate of magnesia 18,6. Silix 64. Carbonate of lime 6,9. Baroselenite 6. Argill 3,3. Oxyde of iron 12. *Bergman.*

l. *Suber Montanum*, cork-like, or resembling brown wood; it is opaque, elastic, of a flaty curve, and irregularly fibrous texture. *Anal.* Carbonate of magnesia 22. Silix 62. Argill 2,8. Carbonate of lime 10. Oxyde of iron 3,2. *Bergman.*

m. *Anctynolite*, amorphous, lamellated, striated, and fibrous; in compressed hexahedral prisms with smooth surfaces. *Anal.* Carbonate of magnesia 20. Silix 64. Carbonate of lime 9,3. Argill 2,7. Oxyde of iron 4. *Bergman.*

n. *Jade*, of a dark leek green or bluish colour; surface smooth, sometimes uneven; in detached round masses, or inhering in rocks; of a splintery texture; feels greasy. *Anal.* Carbonate of magnesia

magnesia 38. Silix 47. Carbonate of lime 2. Argill 4. Oxyde of iron 9. *Hoepfner.*

o. *Baihalite*, crystallized in tetrahedral prisms, entire or truncated, with oblique prisms; and in hexahedral prisms. *Anal.* Magnesia 30. Silix 44. Lime 20. Oxyde of iron 6. *Lowitz.*

p. *Boracite*, found only in the mountain of Kalkberg, near Luneburg; colour greyish white, inclining to purplish; crystallized in cubes, with truncated edges and angles; does not effervesce, or dissolve in acids, unless heat be applied. *Anal.* Boracic acid 68. Magnesia 13. Lime 14. Silix 1. Argill 1. Iron 1. *Westrumb.*

E. ARGILL, or Alumine, aluminous, or argillaceous earth; the earth contained in sulphate of alumine, or common alum, has no taste, and is insoluble, hardens in the fire, although divisible in water, contracting in it's dimensions, and when exposed to an extreme heat, becomes so hard as to strike fire with steel.

a. *Sulphate of Alumine*, or alum, is an earthy salt, which consists of the sulphuric acid and alumine.

b. *Carbonate of Argill*, *Lac lunæ*. Colour pure white, found in nests, in compacted, rounded, kidney-form masses. Consists of carbonic acid, argill and some lime. *Schreiber.*

c. *Clay*, *Pipe Clay*, white, very little greasy to the

the touch, friable and stains the fingers slightly, diffusible in water and ductile; effervesces a little with acids. *Anal.* Carbonate of argill and silex.

d. *Poreelain Clay*, white, and greyish, soft to the touch; when mixed with and moulded into vessels, and exposed to a strong heat, assumes the appearance of a semi-transparent glass; strikes fire with steel; is not acted upon by acids; and preserves it's shape. *Anal.* Argill 60. Silex 20. *Wedgewood.*

e. *Lithomarga*, Mountain soap, friable, indurated, amorphous; texture frequently polished, flaty, conchoidal; colour white, yellowish or reddish white; emits a phosphorescent light, when rubbed in the dark with a pin; soft and soapy to the touch, absorbs water rapidly, and retains it for a long time. *Anal.* Argill 11. Silex 60. Carbonate of lime 5,7. Carbonate of magnesia 0,5. Oxyde of iron 4,7. Air and water 18. *Bergman.*

f. *Fullers Earth*, greenish white colour, or greyish white, receives a polish from friction; does not adhere to the tongue; feels somewhat greasy; falls into powder in water. *Anal.* Argill 0,25. Silex 0,51. Carbonate of lime 0,03. Carbonate of magnesia 0,007. Oxyde of iron 0,03. Moisture and air 0,15. *Bergman.*

g. *Bole*, particles very small, and cohere slightly;

slightly; softens easily in water, but is not fit for pottery; feels greasy; acquires a polish by light friction; of different colours, the red called *Armenian bole*, used for red pencils. The *Terra Lemnia*, which belongs to this tribe, contains silex, argill, magnesia, calcareous earth, iron and water. The indurated bole, or *red chalk*, is hard and brittle, and intimately united with oxyde of iron. *Anal.* Argill 19. Silex 47. Carbonate of lime 5.4. Carbonate of magnesia 6. Oxyde of iron 5.4. Water and air 17. *Bergman.*

h. *Tripoli*, so called from the place whence it was first brought to us; colour whitish, grey or ochre yellow; is found solid; has a dull and earthy appearance when broken; is soft and sandy between the teeth; absorbs water with a noise, during which air bubbles are expelled; does not effervesce with acids, unless mixed with marl, which it often is. *Anal.* Argill 7. Silex 90. Iron 3. *Hasse.*

i. *Lepidolite*, amorphous, foliated. *Anal.* Argill 38.25. Silex 54.5. Oxyde of iron and manganese 0.075. Water and air 2.5. *Klapr.* Silex 54. Alumine 20. Fluete of lime 4. Oxyde of manganese 3. Oxyde of iron 1. Potash 18. *Vauquelin. Lelievre.*

k. *Sappare*, Cyanite, composed of long laminae; white, with shades of sky or Prussian blue; lustre like mother of pearl; it is rather brittle, semi-transparent, soft, and can be scraped with a knife; feels to the touch like talc. *Anal.* Argill 67. Silex

Silex 13. Magnesia 13. Iron 5. Lime 2.
Saussure, jun.

l. *Mica*, lamellated structure, the laminæ sometimes of considerable size, semi-transparent, and the *Muscovy glass* in these laminæ is quite transparent, and is used for windows and lanterns; flexible and elastic; is found of various colours, from silver white to blackish. *Anal.* Argill 28. Silex 38. Magnesia 20. Oxyde of iron 0.
Kirwan.

m. *Micarelle*, found in granite; of a brownish black colour; texture foliated. *Anal.* Argill 63. Silex 29. Oxyde of iron 7. *Klapr. Anal.* Argill 63. Silex 29. Oxyde of iron 7. *Kirwan.*

n. *Hornblende*, Basaltic hornblende, Common hornblende, Schistose hornblende, found of various degrees of hardness, but never so hard as to strike fire with steel; blackish or deep green colour; crystallized in six-sided prisms, the ends acuminate by three faces; and also terminating variously; crystals internally shining; the texture exhibits diverging radiations. *Anal.* Argill 27. Silex 58. Lime 4. Magnesia 1. Lime 9. *Bergman. Conf. Kirwan.*

o. *Resplendent Hornblende*, Labrador hornblende, Schiller spar, colour greyish black, sometimes with a shade of copper red, resembling Labrador stone; texture lamellated; the lamellæ curved. *Anal.* Argill 17. Silex 42. Magnesia 11. Iron 28. *Gmelin.*

Q 2

p. Basalt,

p. *Basalt*, Trap, Wacken, Mullen, Krag; colour blackish green, and sometimes deep black; crystallized in six and eight sided prisms, cuneated on the ends; it's surface shining on being broken; when longitudinally, the lamellæ are parallel. *Anal.* Argill 15. Sillex 50. Carbonate of lime 8. Iron 28. Magnesia 2. *Bergman.* Conf. *Withering.*

q. *Calp*, flaty, amorphous. *Anal.* Argill, filix, and iron, with fifty per hundred weight of carbonate of lime. *Kirwan.*

r. *Argillaceous Schistus*, Argillite, Killas, Grapholite; colour bluish or bluish grey, purplish or black; amorphous and flaty. *Anal.* Argill 25. Sillex 60. Magnesia 9. Iron 6. And some petroleum. *Kirwan.*

f. *Novaculite*, Turkey hone, amorphous and flaty.

F. *SILEX*, is rough to the touch, cuts glass, and scratches metals; is infusible, and insoluble in most acids, except the fluoric, forming Derbyshire spar; soluble in alkalies, with the assistance of heat forming glass; found in most stones that strike fire with steel.

a. *Diamond*, crystallized in octohedrons* and their varieties; and in dodecahedrons† and icosa-

* Octohedrons, ex οκτώ, eight; et εἶσα, basis.

† Dodecahedral, ex δωδεκά, twelve; et εἶσα, basis.

hedrons

hedrons* and their varieties, indeterminate; found in a sandy earth in the hither peninsula of India, in the island of Borneo, and in the Brazils. Diamonds are of a lamellated texture, and may be split by a blow in a proper direction; cut all other substances, and take a most exquisite polish.

b. *Sapphire* is next in hardness to the diamond; the stone worn by the high priest of the Jews; of a sky blue colour, sometimes inclining to pink, sometimes almost white, and then called *lux sapphire*; it is found crystallized in lengthened hexahedral prisms joined base to base. *Anal.* Silix 35. Argill 58. Carbonate of lime 5. Iron 2. *Bergman.*

c. *Topaz of Brazil*, colour various, the true oriental is almost colourless, or pale yellow; the Brazil is of a fine, yellow, transparent amber, crystallized in tetrahedral rhomboidal prisms, terminated by tetrahedral pyramids.

d. *Topaz of Saxony*, crystallized in four-sided rhomboidal prisms, terminating from the sides in flat four-sided pyramids, longitudinally striated, and of a foliaceous texture. *Anal.* Silix 52. Argill 44. Lime 2. Iron 0,03. *Wiegleb.*

e. *Beryl of Siberia*, colour greyish green, verging on the apple green, more rarely bluish green; crystallized in equi-angular hexahedral prisms longitudinally streaked: becomes electric by

* Icosahedrons, ex εικοσι, viginti; et ἰδρα, basis.

friction,

friction, but one of it's poles is attractive whilst the other is repulsive. *Anal.* Sillex 61. Argill 29. Calx 2. Iron $\frac{1}{2}$. Seven parts lost. *Herman.*

f. *Ruby*, of a crimson, deep red colour, which it retains in the fire; crytallized in octohedrons and their varieties, and double four-sided, seldom six-sided pyramids. *Anal.* Sillex 16. Argill 76. Lime 1. Iron 3. *Klaproth.*

g. *Emerald*, Smaragdite, of a pure green colour, which it loses in the fire, as well as it's weight; crytallized in hexagonal prisms, either perfect or truncated on the angles or edges, terminating in truncated pyramids; the crystals mostly smooth on the surface, shining and transparent in various degrees. The light green-coloured oriental emerald is reckoned the best. *Anal.* Sillex 24. Argill 60. Lime 8. Iron 6. *Klaproth.* The Smaragdite has been analysed by *Vauquelin*. The *Green and White Smaragdite* of Corsica. Sillex 50. Alumine 11. Magnesia 6. Lime 13. Oxyde of iron 5,5. Oxyde of copper 1,1. Oxyde of Chrome 4. The *green Smaragdite*. Sillex 51. Alumin 13,5. Magnesia 5. Lime 14,5. Oxyde of iron 8. Oxyde of copper 0,5. Oxyde of Chrome 4. The *Grey*. Sillex 50. Alumine 7. Magnesia 8. Lime 17. Oxyde of iron 14,5.

h. *Aqua Marine*, Aigue marine, crytallized in large, perfect, six-sided prisms; colour of a pale green *Anal.* Sillex 64. Argill 24. Lime 8. Iron 1,5. *Bindheim.*

i. *Crysolite*,

i. *Crysolite*, colour yellowish green, inclining to yellowish brown; crystallized in hexahedral prisms with corresponding pyramids. *Anal.* Silix 15. Argill 64. Lime 17. Iron 1. *Achard.*

k. *Hyacinth*, of a peculiar yellowish red; in general retain their colour in fire; crystallized in dodecahedrons with unequal rhombic faces. *Anal.* Silix 25. Argill 40. Carbonate of lime 20. Iron 13. *Bergman.*

l. *Hyacinth of Vesuvius*, is generally of a deeper colour than the oriental, and is less hard and more fusible. Crystallized in tetrahedral prisms, truncated at their angles, terminated by tetrahedral pyramids, truncated at their summits.

m. *Olivin*, found imbedded in basaltes; of an olive green colour; crystallized in six, seldom in four, sided prisms; mostly rectangular, with or without pyramids. The crystals are longitudinally striated; have a vitreous appearance. *Anal.* Silix 54. Argill 40. Iron 4. *Gmelin.*

n. *Garnet*, Carbuncle, of a red colour, or some of its shades, a greenish white, and of various degrees of transparency; does not lose its colour in the fire, but becomes heavier, and is strongly attracted by the magnet. Crystallized and presenting either 12 rhomboidal planes, or 24 trapezoidal, or 36 planes, of which 12 are rhombs, and the 24 others elongated hexagons, interposed between these rhombs, and some other variations. *Anal.* Silix 48. Argill 30. Lime 11. Iron 10. *Achard.*

o. *White*

o. *White Garnet*, Vesuvian, always exhibits 24 trapezoidal faces, found in volcanic productions; is not fusible by fire like the red. *Anal.* Sillex 55. Argill 89. Lime 6. *Bergman.*

p. *Tourmalin*, of a deep brown, hyacinth, or green colour; does not strike fire with steel; can be scratched by a knife; crystallized in six or nine-sided prisms, longitudinally streaked, and terminating in three-sided pyramids with pentagonal faces. Is electric when heated. *Anal.* Sillex 37. Argill 29. Lime 15. Iron 9. *Bergman.*

q. *Schorl*, of various colours, red, black, greyish white, but generally green; somewhat transparent; scratches glass, and most varieties strike fire with steel; crystallized in six or nine-sided prisms, with three-sided pyramids. *Anal.* Sillex 52. Argill 37. Lime 5. Magnesia 3. Iron 3. *Chaptal.*

r. *Thunerstein*, Violet schorl, vitreous appearance, more or less transparent; cuts glass, and strikes fire with steel; found in flat rhomboidal crystals, with the two opposite edges a little truncated; the surface of the sides streaked, and the surface of truncation smooth and shining. *Anal.* Sillex 52. Argill 25. Lime 9. Iron 9. And some manganese. *Klaproth.*

f. *Schorlite*, crystallized, indeterminate. *Anal.* Sillex 50. Argill 50. *Klaproth.*

t. *Rubellite*, crystallized in diverging striated prisms,

prisms, with trihedral summits. *Anal.* Silex 57. Argill 35. Oxyde of iron and manganese 5. *Bindheim.*

u. *Amethyst*, crystallized in hexahedral prisms, with corresponding pyramids; of various degrees of transparency, and colour. *Anal.* Silex 30. Argill 60. Lime 22. Iron 1,66. *Achard.*

v. *Quartz*, crystallized in double hexahedral pyramids, with or without an intermediate prism; of various shapes; strikes fire with steel; is soluble in fluoric, but not in nitric or muriatic acid; *Anal.* Silex 93. Argill 6. Lime 1. *Bergman.*

w. *Prase*, of a leek green colour; crystallized in six-sided prisms, acuminated by six faces, proceeding from the sides of the prisms.

x. *Elastic Quartz*, amorphous, angular. *Anal.* Silex 0,965. Argill 0,025. Iron 0,01. *Klaproth,*

y. *Obsidian*, *Iceland Agate*, of a greyish or blackish colour; found in irregular shaped pieces. *Anal.* Silex 69. Argill 22. Iron 0,009. *Bergman.*

z. *Calcedony*, *Cornelian*, *Agate*, called *Calcedon*, from the name of a place; usually found in solid masses, of a globular, kidney-like, or stalactical figure, or in the state of pebbles; sometimes filiform, tabular or cellular; of a greyish, yellowish, white, or milk white colour. *Anal.* Silex 84. Argill 16. *Bergman.*

R

a a. *Chryso-*

a a. *Chrysoprase*, of a green, or greenish white colour; found in solid masses, and breaks with an even surface, having a dull appearance; does not strike fire with steel. *Anal.* Silix 0,96. Oxyde of Nickel 0,01. Lime 0,0083. Argill 0,0083. Oxyde of iron 0,0083. *Klaproth.*

b b. *Hyalite*, amorphous, lamellar, compact, colour pure white, fracture even, lamellated, sometimes conchoidal. *Anal.* 57. Argill 18. Lime 15. And a very little iron. *Link.*

c c. *Opal*, Semi-opal, hard and semi-transparent; reflects the light in various hues; found of a milk white, bluish white and greenish colour, rarely purple; takes a fine polish, but is not so hard as to strike fire with steel. *Anal.* Silix 98,75. Argill 0,01. Oxyde of iron 0,01. *Klaproth.* Of this class are *Hydrophanes*, which become transparent by placing them in water.

d d. *Pitchstone*, crystallized in hexahedral prisms with trihedral pyramids; its various colours are white, yellow, brown, greenish, seldom transparent; scratches glass. *Anal.* Silix 73. Argill 18. Iron 00,58. *Wiegleb.*

e e. *Cats-eye*, amorphous, compact, colour greyish white, yellowish or reddish brown, or striped with these colours, particularly when polished. Found in blunt or rounded fragments, and comes from Ceylon.

f f. *Flint*, strikes fire with steel, generally of a yellowish

yellowish smoke grey, or black grey colour; crystallized in double trihedral pyramids; in masses of various sizes, in strata of chalk; when broken, exhibits a conchoidal surface, and the fragments are sharp edged, but of an indeterminate shape; semi-transparent. *Anal.* Silix 60. Argill 18. Lime 2. *Wiegleb.*

g g. *Hornstone, Siliceous Schistus, or Basanite, Hornslate. Petrosilex.* Crystallized in hexahedral prisms, with or without pyramids, in double trihedral pyramids, in cubes; amorphous, compact; flaty; colour various, yellowish white, bluish, pearl, green inclining to red, brownish, rose colour, blackish brown. *Anal. Hornstone.* Silix 72. Argill 22, Carbonate of lime 6. *Kirwan. Basanite.* Silix 73. Lime 10. Magnesia 0,046. Iron 3. Coal 5. *Weigleb. Hornslate.* Silix 73. Argill 24. Iron 3. *Wiegleb.*

h h. *Jasper, Egyptian Pebble,* found in irregular hexahedral prisms; amorphous, in large masses and nodules, and of all colours. *Anal.* Silix 54. Argill 30. Iron 16. *Delametherie.*

i i. *Porcelanite, Porcelain Jasper,* of a pearl grey, or lavender blue colour; found in compact layers. It's surface, when newly broken, is a little skinny and gibbous.

k k. *Heliotropium, Bloodstone,* of a leek green colour, with blood-red spots or veins; is semi-transparent; exhibits a conchoidal surface when broken.

It may be observed that Agates do not form a distinct species of stone, but consist of quartz, crystal, hornstone, flint, calcedony, amethyst, jasper, cornelian, heliotropium, jade, &c. in various combinations, and may be exhibited in the following manner, from *Kirwan*.

The clear pellucid white de-	notes	-	-	crystal or quartz.
The yellowish white	-	-	-	amethyst, calcedony;
The greyish white	-	-	-	quartz;
The milk white	-	-	-	jasper, amethyst;
The yellowish grey	-	-	-	quartz, flint;
The smoke grey	-	-	-	calcedony, flint;
The pearl grey	-	-	-	calcedony;
The greenish grey	-	-	-	calcedony, jasper;
The bluish grey	-	-	-	calcedony.
The honey yellow	-	-	-	flint, jasper;
The yellow	-	-	-	jasper;
The ochre yellow	-	-	-	calcedony;
The orange yellow	-	-	-	calcedony;
The yellowish brown	-	-	-	cornelian;
The reddish brown	-	-	-	hornstone, cornelian;
The flesh red	-	-	-	cornelian;
The blood red	-	-	-	jasper, cornelian;
The brick red	-	-	-	jasper.
The violet blue	-	-	-	amethyst;
The brownish green	-	-	-	heliotropium;
The leek green, and feeling somewhat greasy	-	-	-	jade.

11. *Feltspar*, *Adularia*, or Moonstone, crystallized in tetrahedral prisms, truncated obliquely,
and

and their varieties; transparent; shining lamellæ, placed one over the other, often in an irregular manner; but it's figure approaches always either to the cubical or rhomboidal. *Anal.* Silix 62. Argill 17. Lime 6,5. Baroselenite 2. Magnesia 6. Iron 1,4. *Westrumb.*

m m. *Common Feltspar*, of a pale flesh colour, yellowish, grey, milk white; rarely of a vivid green or bluish colour; opaque, compact, strikes fire with steel. *Anal.* Silix, argill, with lime and magnesia, or baryte. *Kirwan.* Silix 62,83. Alumine 17,002. Lime 3. Oxyde of iron 1. Loss. 16,015. *Vauquelin.*

n n. *Labrador Feltspar*, amorphous, foliated, of various hues, light or deep grey, but when held in certain directions to the light, reflects lazuliblu, green, and lemon yellow, coppery or violet colour, the surface shining, texture foliated, fragments rhomboidal. *Anal.* Silix 69. Argill 13. Sulphate of lime 12. Oxyde of copper 0,7. Oxyde of iron 0,04. *Bindheim.*

o o. *Argentine Feltspar*, crystallized, as common feltspar; amorphous, foliated. *Anal.* Silix 46. Argill 36. Oxyde of iron 16. *Dodun.*

p p. *Stauroelite*, crystallized in tetrahedral prisms, with tetrahedral pyramids, either single, or crossing each other at right angles. *Anal.* Silix 44. Argill 20. Baryte 20. Water 16. *Westrumb.*

q q. *Lapis*

q q. *Lapis Lazuli*, is opaque, compact, and never found crystallized; amorphous, seldom pure; of a sky-blue colour, which it retains in the fire for a long time, but at length becomes brown. *Anal.* Silix, lime, sulphate of lime, and iron. *Margraff.*

r r. *Prehnite*, so called by Werner, after Capt. Prehn, who brought it first to Europe from the Cape in 1783. Crystallized in tetrahedral prisms; indeterminate; amorphous, foliated; semi-transparent and brittle; surface shining, with a lamellated, or fibrous texture; of a greenish grey colour. *Anal.* Silix 44. Argill 30. Lime 18. Iron 5. Water and air 2. *Klaproth.*

f f. *Adelite*, of particular shapes, tuberous. *Anal.* Silix 62 to 69. Argill 18 to 20. Lime 8 to 16. Water 3 to 4. *Bergman.*

tt. *Zeolite*, opaque, seldom semi-transparent; hard, but rarely so hard as to strike fire with steel; of a pale green, silver white and honey colour, sometimes of a bluish or coppery hue; crystallized in cubes; it is found compact, fibrous, radiated, lamellated, uniform, stalactical, in drops, and of a capillary shape, in which it is very beautiful; in six-sided and flat prisms. *Anal.* Silix 50. Argill 20. Lime 8. Water 22. *Pelletier.*

u u. *Siliceous Spar*, crystallized in tetrahedral, and in hexahedral prisms. *Anal.* Silix 61,1. Lime 21,7. Argill 6,6. Magnesia 5. Oxyde of iron 1,3. Water 33. *Bindheim.*

v v. *Rose*

v v. *Rose Spar*, Red Stone, crystallized, indeterminate; amorphous, thick foliated.

C. *ADAMANTINE EARTH*, or *CORUNDUM*, discovered by Klaproth, in adamantine or diamond spar.

a. *Adamantine Spar*, of a greyish colour, inclining to greenish white, chocolate brown, &c. cuts glass, and scratches other gems; strikes fire with steel; is not affected by sulphuric, nitric, or marine acid; exhibits six-sided short rhomboidal prisms, rounded on the top, of a lamellated texture, shining in certain directions. *Anal.* Adamantine 68. Silix 31,5. Iron and nickel 00,05, *Klaproth*.

Corundum of China. of Peninsula of India.

Argillaceous earth	89,50	—	84,0
Siliceous earth	5,50	—	6,50
Oxyde of iron	1,25	—	7,50
Loss	—	—	2,0
	100,0		100,0

Chs. Grevillé.

H. *JARGON EARTH*, discovered by Klaproth, in the stone called jargon, or zirgon, of Ceylon.

a. *Jargon*, crystallized in short tetrahedral prisms, with tetrahedral pyramids; indeterminate, in small grains, and small flat pebbles; scratches glass;

glafs: bears a greater heat than the diamond before it is consumed. *Anal.* Jargon earth 68. Silix 31. Iron and nickel 5. *Klaproth.*

I. *SIDNEIAN EARTH*, discovered by Wedgewood; it is contained in a compound substance from Sidney Cove in South Wales; consisting of fine white sand, some colourless mica, a few black particles resembling black lead, and a white argillaceous earth, and from which the new earth is extracted by the marine acid.

a. *Sidneia*, amorphous, loose. *Wedgewood.*

II. MIXED.

A. *CALCAREOUS*. Calcareous earth, in it's most common state, is called limestone, or spar; it is in this state that it is combined with a peculiar acid, expellable by heat, and hence called aërial acid, fixed air, or carbonic acid; it effervesces with acids in general: it's more mixed state is now considered.

a. *Marl*, Argillo-Calcite, semi-indurated or earthy form, of a yellowish grey, or yellowish white colour; loose texture, strongly effervesces with acids; in water soon falls into powder. In a stony or indurated state, fracture earthy, sometimes splintery, or conchoidal, frequently flaty; colour various, yellow, grey, brown or bluish. *Anal.* Carbonate of lime 60 to 80. Remainder argill; and flex. *Kirwan.* In it's stony or indurated

durated slate, colour yellow, grey, brown, or bluish; texture splintery or conchoidal, frequently flaty; penetrated by bitumen, sulphur, and pyrites. *Kirwan.*

b. *Limestone with argyllite.*

c. *Siliceous Limestone.*

d. *Ferruginous Limestone.*

e. *Gypsum with Calcareous Spar*; Gypsum is frequently penetrated with this spar, swinestone, sandstone, and perhaps with stromantian; which cause a change in it's hardness and gravity, and of colour from blackish to whitish grey.

f. *Gypsum with Marl*; sometimes disguised with iron; colour reddish brown, and reddish black; effervesces with acids; gives a red streak.

B. MAGNESIAN.

a. *Calciferous Asbestinite.*

b. *Steatite with Argill.*

c. *Serpentine with Hornblende.*

d. *Siliciferous Potstone*; bluish black, mixed with white; it's fracture uneven, partly splintery, partly flaty; the quartz in many parts visible in the veins.

S

e. *Ferrugi-*

e. *Ferruginous Steatite.*

C. ARGILLACEOUS.

a. *Calciferous Argillite*; colour dark, blackish, or bluish grey, or grey with black or deep blue blotches, or reddish or yellowish grey; more rarely greenish grey; fracture slaty, but of single laminæ, splintery, or conchoidal.

b. *Talcose Argillite*; colour whitish, or bluish, or greenish grey; often invested with foliated steatites; found in large masses; fracture slaty, curved.

c. *Siliciferous Argillite*; penetrated with filiceous schistus, sand, jasper, basanite, or quartz; colour dark, blackish, or bluish grey, rarely greenish grey; fracture slaty, but of single laminæ; splintery, or conchoidal.

d. *Ferruginous Argillite*; penetrated with calces of iron, of a bluish brown colour; externally, it has some lustre; internally, none; somewhat of a striated, as well as of a slaty appearance.

e. *Hornblende with Garnet*; of a dark greenish red, or reddish dark green, according to the proportion of garnet; fracture earthy, or fine splintery.

f. *Hornblende Slate with Talc or Mica*; colour greenish grey; fracture slaty, and thin, the laminæ not easily separable; found in great plenty
at

at Holyhead, and has for the most part thick layers of quartz intercepted between it's laminæ.

g. *Hornblende Slate with Quartz*; colour ochre yellow, with black shining streaks of hornblende; fracture schistose; feels sandy; resembles gneiss; the yellow colour seems to proceed from a ferruginous quartz.

h. *Trap with Hornblende*; colour bluish, or greenish black; fracture fine splintery; contains some grains of magnetic ironstone.

i. *Trap with Mullen*; colour greyish black, with a shade of red, fracture uneven and fine splintery.

k. *Trap with Krag*; colour greyish black, with a shade of red; fracture uneven and fine splintery.

l. *Siliciferous Trap*; colour blackish grey, or dark iron grey, with numerous rounded white specks, as small as the point of a pin; it is also full of rifts, and these exhibit a bluish or reddish ferruginous illiniton; fracture uneven and splintery.

m. *Ferruginous Clays*; some are so penetrated with calces of iron, as scarcely to indicate a slaty texture; colour bluish brown; externally some lustre; internally none; readily imbibes water.

n. *Mullen with Asbestinite*; colour of a reddish grey when first broken, with very little lustre; fracture uneven and earthy.

D. SILICEOUS.

a. *Earthy Quartz*; structure loose as that of moss, which it resembles; exceedingly brittle, and light as pumice; colour white, greyish, and dark.

b. *Ferruginous Quartz*; hard, fracture splintery; colour brown, or brownish purple; sometimes schistose, sometimes of the texture of moss.

c. *Earthy Quartz with Actinolite*; greenish grey colour, with yellowish green lumps, and specks and blotches of red; fracture splintery and uneven.

d. *Earthy Hornstone*, resembles earthy quartz, but of a finer and closer grain; colour reddish grey mixed with green, brownish or blackish; structure thick flaty; fracture splintery.

e. *Ferruginous Hornstone*; hard and close grained, colour reddish brown; gives a pale red streak.

f. *Siliceous Schistus with Limestone*; of a dark yellowish grey colour; fracture splintery; the grain very fine and close.

g. *Siliceous Schistus with Argillite*; colour light bluish grey or purplish grey; fracture fine splintery; in the gross, flaty.

h. *Siliceous*

h. *Siliceous Schistus with Mullen*; colour bluish grey, it's surface often stained reddish or yellowish brown; fracture fine, splintery, and uneven.

i. *Pitchstone with Opal*; of a pearl grey, resembling porcelainite; penetrated with lumps of opal; brittle; imbibes water slowly; decrepitates strongly by heat, and then whitens, and remains in a loose powder.

III. AGGREGATED.

A. CALCAREOUS.

a. *Calcareous Sandstone*; crystallized in rhomboids; amorphous; colour generally white or grey, or yellowish white; surface rough; fracture earthy or slaty; often spangled with mica. *Anal.* Carbonate of lime 37,5. Silex 62,5. *Lassone.*

b. *Calcareous Breccia*; consisting of fragments of marble in a calcareous cement.

B. MAGNESIAN.

a. *Potstone Porphyry*; amorphous, undulatingly foliated; greenish, reddish, or yellowish grey; or speckled earth; red or leek green; containing potstone and felspar.

b. *Serpentine Porphyry*; amorphous, compact; dark or olive green, grey, or reddish; fracture splintery; found near Florence, containing serpentine and felspar.

C. ARGIL-

C. ARGILLACEOUS.

a. *Argillaceous Sandstone*; amorphous, flaty, and compact; does not effervesce with acids; often shot through with mica; make mill-stones, filtering-stones, and coarse whetstones; composed of argillaceous cement, with fragments of quartz, felspar, and flint.

b. *Ruddle Stone*; amorphous, flaty, and compact; containing argillaceous cement, with quartz, siliceous schistus, or hornstone and argillite.

c. *Argillaceous Porphyry*; amorphous; contains felspar in indurated clay; hornblende, trap, wakken, mullen, krag, or argillite.

d. *Amigdaloid*; amorphous; containing rounded masses of calcedony, agate, zeolite, calcareous spar, lithormaga, steatite, green earth, &c. in an argillaceous basis.

e. *Schistose Mica*; amorphous, flaty; contains mica and quartz.

D. SILICEOUS.

a. *Granite*; amorphous, compact, flaty; chiefly composed of quartz, felspar, and mica; the compact parts generally irregularly mixed, and of various sizes.

b. *Sienite*; amorphous, compact, flaty; composed of quartz, felspar, and hornblende; or of quartz,

quartz, felspar, hornblende, and mica; sometimes found flaty.

c. *Granatine*; composed of quartz, felspar, schorl; quartz, felspar, garnet; &c. &c. &c. *Saussure*.

d. *Granitell*; or Grunsten; amorphous; composed of quartz, felspar; quartz, schorl; quartz, mica, &c. *Kirwan*.

e. *Granalite*; amorphous; composed of quartz, felspar, mica, schorl; quartz, felspar, mica, steatite, &c.

f. *Gneiss*; amorphous; flaty, fibrous, lamellated; contains quartz, felspar, and mica. *Werner*. *Saussure*.

g. *Siliceous Porphyry*; amorphous; compact, flaty; consisting of crystals of felspar in a basis of jasper, hornstone, pitchstone, obsidian, filiceous schistus, schistose hornblende or felspar.

h. *Pudding Stone*; amorphous; consisting of rounded pebbles in a filiceous cement.

i. *Siliceous Sandstone*; amorphous; the grains often slightly compacted together, and easily breaking into sand; of this kind is *Salindre*, consisting of calcareous grains, inserted in a filiceous cement.

k. *Siliceous Breccia*; amorphous; consisting of angular fragments of filiceous stones in a filiceous cement.

CLASS

CLASS III.

M E T A L S.

THE most ponderous of all mineral bodies, fusible, but resuming their original properties when cold, even after calcination, by the addition of inflammable matter, or oxygen gas: in their purest metallic state, they possess neither taste nor smell. There are 23 metals with which we are acquainted, of these 8 are considered as ductile, or entire metals; and 15 as fragile or semi-metals; of the former are, 1. Platina. 2. Gold. 3. Quicksilver or Mercury. 4. Silver. 5. Lead. 6. Copper. 7. Iron. 8. Tin. Of the fragile are, 1. Bismuth. 2. Nickel. 3. Arsenic. 4. Cobalt. 5. Zinc. 6. Antimony. 7. Manganese. 8. Scheele, Wolfram, or Tungsten. 9. Uranite. 10. Molybdena. 11. Menachanite. 12. Sylvanite. 13. Titanite. 14. Chrome. 15. Tellurium.

From recent experiments made on the Carbonates of Barytes, Magnesia, and Chalk, three new metals are supposed to exist, which Mr. Tondi, the discoverer, has named *Barbonum*, *Austrum*, and *Parthenum*; for which Mr. Kerr would substitute the names of *Barytum*, *Magnesium*, and *Calcum*,

Calcum, as more consistent with the new chemical nomenclature; but further experiments are requisite to determine the truth of those already made, as they are doubted by some eminent chemists.

I. DUCTILE.

A. **PLATINA**, Plata Silver, or Platina de Pinto; found only in Spanish America in small grains among the gold mines there; introduced into England in the year 1749. It is usually united with iron, and in it's crude state is 18 times heavier than water, and when pure is heavier than gold, it's specific gravity being $21\frac{1}{2}$. With a strong white heat it's parts will adhere together by hammering. The best solvent is aqua regia, composed of equal parts of the nitrous and marine acids.

B. **GOLD** is a yellow metal, 19 times heavier than water; unalterable by air, or fire; soluble in aqua regia, composed of three parts of nitrous and one of marine acid, and may be precipitated by various substances; lime and magnesia precipitate it in the form of a yellow powder; the nut-gall precipitates it of a reddish colour; the volatile alkali of a brown, yellow, or orange colour, known by the name of fulminating gold, and this powder weighs a fourth more than the gold made use of; liver of sulphur precipitates

T

it,

it, by the alkali uniting with the acid, when it falls down combined with the sulphur; lead, iron, and silver precipitate it of a deep and dull purple colour; copper and iron throw it down in it's metallic state. A plate of tin immersed in a solution of gold, affords a purple powder, called the purple powder of Cassius, which is used to paint in enamel. Most metals unite with gold in fusion, hence it is generally found alloyed with silver, copper, iron, or other metals.

a. *Native Gold*; found in it's metallic state, crystallized with silver, copper, or iron.

b. *Grey Ore*; combined with sulphur, antimony, arsenic, lead, iron, and silver. *Born.*

c. *White Ore*; combined with silver, bismuth, and sulphur.

The largest quantities of gold are brought from the Brazils and the Spanish West Indies. This metal is found also in Hungary, Transylvania, and in many other parts of Europe, in red, yellow, black, or iron-coloured sands; it is met with likewise in some rivers, as the Tagus, Ganges, Rhine, Saale, Niger, Danube, &c. called river, wash-gold, or gold-dust.

C. QUICKSILVER.

QUICKSILVER, or Mercury; the most fluid of all metals, not taking a solid state until cooled to

to the 29th degree below 0 on Fahrenheit's thermometer, when it becomes malleable; it is 14 times heavier than water, easily divisible, and evaporates in a heat below ignition; rapidly soluble in the nitrous acid. Mercury is found in Hungary, Transylvania, Carinthia, Bohemia, France, Spain, Sweden, Peru, and probably in the East Indies and Japan.

a. *Native Quicksilver*; fluid, or interspersed; sometimes called virgin mercury.

b. *Amalgamized Mercury*; alloyed with silver; found on Moschellandsberg and Stahlberg in Deuxponts, near Sahlberg in Sweden, near Zlana in Hungary, chiefly on a grey indurated clay.

c. *Cinnabar*; combined with sulphur, in various forms, scaly, granular, indeterminate.

d. *Hepatic Ore*; Mercury combined with sulphuret of potash or soda.

e. *Cupreous Mercury*; Quicksilver combined with copper, chiefly on lapis ollaris and quartz. Found in the mines near Moschellandsberg.

D. SILVER.

SILVER, when pure, is 11 times heavier than water; the whitest of all metals; harder, but less malleable than gold; soluble in the nitrous and vitriolic acids. Silver is found in all countries, but most plentifully in Peru and Potosi.

T 2

a. *Native*

a. *Native Silver* ; found generally of about 16 carats standard.

b. *Arsenical Silver* ; cryſtallized with arſenic and iron.

c. *Horn Silver* ; reſembling reſin in colour, containing muriatic acid, fulphuric acid, iron, argill, and lime.

d. *Vitreous Silver*, or Glaſs ſilver ore, of a dark colour like lead ore, contains fulphur, is ductile.

e. *Brittle Vitreous Ore*, contains iron, antimony, fulphur, copper and arſenic.

f. *Red Silver Ore* ; a brittle red-coloured ore, containing regulus of antimony and fulphur, and fulphuric acid. The ſilver is in proportion of 62 to 100. *Klaproth*.

g. *White Silver Ore* ; combined with lead, antimony, fulphur, iron, ſilex, argill ; of a light grey colour, and of a dull ſteel-grained texture.

E. LEAD.

LEAD is above 11 times heavier than water, unſonorous, malleable, and very fuſible, ſoluble in all acids and alkaline ſolutions. It yields an oxyde more vitrifiable than the oxyde of any other metal, and a glaſs of a topaz-yellow colour.

a. *Native*

a. *Native Lead*; found in Poland; Silesia, near Karthen, and in Monmouthshire; also in Carinthia, in Vivarais.

(a.) 2. *Native Oxyde of Lead*; crystallized in various forms; compact, or pulverulent. *Anal.* Lead 36. Oxygen 37. Iron 24. Argill 2. *Macquart*.

(a.) 3. *Molybdate of Lead*; crystallized in rectangular tables and their modifications.

b. *Lead Amalgam*; or lead combined with mercury.

c. *Red Lead Ore*, or Ferruginous oxyde of lead; resembling arsenic or realgar; crystallized, shining, striated on the surface; semi-transparent.

d. *White Opaque Lead Ore*, or Native White Lead; of a yellowish or greyish colour. Found at Blegberg.

e. *White Carbonate of Lead*, { Chalk of lead.
Spathose lead.
Mephite of lead.

Spathose lead ore, White transparent lead ore, or White lead spar; colour white or colourless, usually mixed with calcareous earth or clay. Found near Freiburg, Marienberg, in Siberia, Bohemia, Hungary, Tipperary in Ireland, and lead hills in Scotland. *Anal.* Lead 80. Carbonic acid 16, with some lime and argill. *Westrumb*.

f. *Black*

f. *Black Lead Spar*; of a yellowish green, or verdegris colour; of a truncated hexahedron form; found on the lead-hills.

g. *Brown Lead Ore*; of a reddish brown colour, in four-sided prisms; found in Tipperary, also at Zschopau.

h. *Native Glass of Lead*; deposited upon calcareous spar, resembling mica; found at Bergmantorff, near Zellerfeld, on the Harz.

i. *Antimonial Lead Ore*; of an iron grey colour. Found at Sahlberg in Sweden, in Siberia; at Lautenthal on the Harz; and in Hungary. *Anal.* Lead 40,50. Antimony 8,16. With some silver.

k. *Galena*; Sulphuret of Lead, or Sulphurated lead ore; one of the most common lead ores, combined with sulphur, sometimes silver, iron and antimony; it's matrix is generally heavy spar, fluor, quartz, coal, spathose iron ore, schistus and gneiss. Found at Bleystedt in Bohemia, Freiberg in Saxony; Siberia, Sahlberg in Sweden, and in Derbyshire. *Anal.* Lead 77. Sulphur 20. Silver 1. *Kirwan.*

l. *Pyritical Lead Ore*; combined with martial pyrites.

m. *Sulphate of Lead*, Vitriol of Lead; found in

in octohedrons, and their modifications; of a yellowish brown colour; matrix upon a ferruginous quartz or schistus. Found in Anglesea, Wales; and near Strontian, Scotland.

n. *Phosphorated Lead Ore*; lead combined with phosphoric acid; shining, semi-transparent; found near Freiberg, Zschoapau, Johanngeorgenstadt, Zellerfeld, and in the lead hills, Scotland.

o. *Yellow Lead Ore*; or lead combined with acid of Tungsten; yellow or orange coloured lamellated, semi-transparent; is the molybdate of lead of Klaproth, who found it combined with the molybdenic acid. It is found at Bleiberg in Carinthia, near Villach, near Zellerfeld, and in the lead hills in Scotland.

F. COPPER.

COPPER, when pure, is near nine times heavier than water; the most sonorous of all metals, dissolves in all acids and alkaline solutions, oils and water. The least quantity of this metal, in solution, turns blue by the addition of volatile alkali: united with calamine, it forms brass; with tin, bell-metal.

a. *Native Copper*; malleable, fibrous, fusible, generally found adhering to other fossil substances; crystallized in cubes, octohedrons, compact, laminar, granular.

b. *Native*

b. *Native Oxyde of Copper*; found in compact lumps, sprinkled in the state of small particles, of a hyacinth colour. Sometimes resembling brown pitch, or of a steel grey, and brownish red. Crystallized in cubes and octohedrons.

c. *Pitch Copper Ore*, hyacinth red; little shining, soft, compact, pulverulent; containing oxyde of copper with oxyde of iron. *Born.*

d. *Carbonate of Copper*; Malachite, sky blue, mostly pulverulent, crystallized in rectangular octohedrons and various; stalactitical. Found in Tyrol. *Anal.* Copper 73, Carbonic acid 26. *Fontana.*

e. *Arseniate of Copper*; of a deep olive, or emerald colour, semi-transparent, crystallized in various modifications. *Anal.* Copper 73. Carbonic acid 26. *Fontana.*

Synonymous Names.

f. *Sulphate of Copper*, { Vitriol of Cyprus.
Blue Vitriol.
Vitriol of copper, or of Venus.
Blue copperas.

crystallized in tetrahedral prisms, and their modifications, shining, colour brassy yellow: contains copper, iron, and sulphur.

g. *Muriate* of Copper*; amorphous, in a sandy

* Salt formed by the union of the muriatic acid with different bases.

form.

form. *Anal.* Copper 52. Acid 10. Oxygen 11. Water 12. Sand 11. *Rochevoucauld.*

h. *Sulphuret of Copper*, Vitreous Copper Ore, or Pyrites of Copper; of a lead grey colour, crystallized in hexahedral truncated prisms; contains copper with sulphur; sometimes a little silver or arsenic. Found at Freiberg.

i. *Variegated Copper Ore*; exhibiting various colours; intermixed with copper pyrites and vitreous copper. Found at Freiberg.

k. *Yellow Copper Ore*; crystallized in equilateral tetrahedrons, and various; composed of copper, iron and sulphur.

l. *Grey Copper Ore*; crystallized in tetrahedrons and their modifications, and in six-sided prisms. *Anal.* Copper 16. Lead 34. Antimony 16. Iron 13. Sulphur 10. Silver 2. Silica 2. *Klaproth.*

m. *White Copper Ore*; silver white, brittle; on rubbing emits an arsenical smell; compounded of copper, iron, and arsenic. Found near Freiberg.

G. IRON.

IRON is about eight times heavier than water, is attracted by one of its ores, called the loadstone; soluble in all acids, alkaline solutions, water, and air; its solution is turned of a black or

U

dark

dark purple colour, by galls, and other vegetable astringents.

a. *Native Iron*; various, irregular, malleable; of an iron grey colour; found at Kamsdorf, in Siberia; and South America.

b. *Grey Iron Ore*, *Magnetic Iron Stone*, *Emery*; shining, copper red colour, a little attracted by the magnet; crystallized in octohedrons, and in cubes; lamellated, foliated, granular, and various; contains iron united to a small proportion of oxygen.

c. *Hematite*; of a blood red, or steel grey colour; found solid, reniform, fibrous, scaly and various; found at Schneeberg, &c.; contains iron with carbonic acid and argill. *Kirwan.*

d. *Argillaceous Iron Ore*, *Basaltic Iron Ore*; reniform, globular, lenticular, granulated, various; found at Bohnerz in Germany; contains iron united to oxygen, carbonic acid and argill, and often phosphate of iron.

e. *Spathose Iron Ore*; of a greenish grey cream colour, or chocolate brown; crystallized in rhombs, and in double, three, and six-sided pyramids, foliated; found near Freiberg, Kamsdorf, &c. in Germany. *Anal.* Iron 38. Lime 38. Carbonic acid and manganese 24. *Bergman.*

f. *Sulphate*

Synonymous Names.

f. *Sulphate of Iron.* { Martial vitriol.
Green vitriol.
Vitriol of iron.
Green copperas.

a combination of the sulphuric acid with iron.

g. *Sulphuret of Iron*, Martial Pyrites; crystallized in tetrahedrons, and their modifications, in cubes, octohedrons, solid, interspersed, capillary, striated; consists of iron and sulphur.

Mr. David Muschet, of the Clyde iron works, divides iron-stones into,

1. Argillaceous Iron-stone, having clay for it's chief component earth, and this clay comparatively pure and free from sand.

2. Calcareous Iron-stone, possessing lime for it's chief mixture, and this lime also comparatively destitute of sand.

3. Siliceous Iron-stone, uniting clay and lime, containing large proportions of filex.

4. Iron-stone containing nearly the same proportions of clay, lime and filex.

Besides these are described, "Primary ores of iron," so named in contradistinction to ores which appear, like iron-stones, to have been formed by a secondary agency.

H. TIN.

TIN is a silver-coloured glittering metal, seven times heavier than water; does not vitrify like lead; is malleable and unsonorous; soluble in aqua regia, vitriolic, muriatic, nitric and acetic acids; yields a white oxide that impairs the transparency of glass, and converts it into enamel. Found in Cornwall and Bohemia.

a. *Native Tin*: pure native tin is so very rare, that its real existence has been doubted.

(a.) 2. *Native Oxide*, Spathose tin ore; tin combined with oxygen and iron; is found in various modifications.

b. *Brown Tin-stone and Spar*; consists of calx of tin, calx of iron, and acid of tungsten.

c. *Wood Tin*, Stream Tin, or Cornish Tin Ore; found only in Cornwall, in small globular or reniform pieces, sometimes of a fibrous or radiated texture; containing tin, with oxygen and iron.

d. *Tin Pyrites*, Sulphurised Tin, or Sulphuret of Tin; contains tin, sulphur, copper and iron, besides its matrix; it is distinguished by its sulphureous smell when heated.

II. FRAGILE.

A. BISMUTH.

BISMUTH is of a white yellowish colour, and laminated texture; above nine times heavier than water, very fusible, soluble in the sulphuric muriatic and nitric acids, and particularly in the last, and when dissolved in it, is precipitable by a mere dilution with pure water; the precipitate is white. Found plentifully in Saxony, Bohemia, Sweden.

a. *Native Bismuth*, of a silver white colour, inclining to reddish. It's matrix is red jasper, petrosilex, quartz, heavy spar, and cobalt ores. Found crystallized in equilateral triangular laminæ; indeterminate; in small particles, foliated. Separated from it's matrix by simple fusion; being itself easily fusible.

b. *Native Calx, or Oxyde of Bismuth*; without lustre; friable, loose, or compact; of an earthy appearance; emitting no sulphureous smell when ignited; soluble in nitric acid; of a yellowish grey, greenish, and straw yellow grey.

c. *Sulphurised Bismuth, or Sulphuret of Bismuth*; of a lead grey and bluish grey colour; sometimes variegated; amorphous, striated, foliated, loose and dispersed. *Anal.* Bismuth 60. Sulphur 40. *Sage.*

d. *Martial*

d. *Martial sulphurated Bismuth.* Of a radiated texture; yellowish grey colour. Found near Gillabet in Norway.

e. *Arsenicated Bismuthic Ore;* of a yellowish white colour; brilliant lustre; emits a garlick smell when ignited; consists of bismuth, arsenic, and sulphur. Found at Schneeberg in ferruginous jasper, accompanied with cobalt ore.

B. NICKEL.

Found generally in a metallic state, more rarely in the state of calx. When free from heterogeneous substances, is of a grey reddish white, or flesh colour; when broken, has a strong lustre; of a fine-grained, compact texture; has a little ductility; is soluble in sulphuric, muriatic, and particularly nitric acid.

a. *Native Nickel;* copper-red colour; exhibits a conchoidal surface when broken; crystallized in rhomboidal tables; amorphous, foliated. It's matrix is calcareous spar, and heavy spar. *Anal.* Nickel alloyed by iron. *Born.*

b. *Native Calx or Oxyde of Nickel;* colour of a pale green, or bluish green; has an earthy appearance; is friable; sometimes shining. *Klaproth* found it mixed with filiceous, argillaceous, magnesian, and calcareous earth.

c. *Kupfer Nickel,* copper-red colour; deeper than

than the purified metal; of particular shapes; amorphous, granular, compact. *Anal.* Nickel united to iron, arsenic, cobalt, and sulphur. *Bergman.*

C. ARSENIC.

ARSENIC is about eight times heavier than water, appears in plates of a bluish grey colour, may be discovered by evaporating it upon red-hot coal or iron, by means of which a garlic smell is emitted. The fumes deposit a white coating on a plate of copper. It is not acted upon by water, but readily by nitric acid. Phlogisticated alkali dropped into it's solution, produces a green precipitate.

a. *Native Arsenic*, Testaceous Arsenic; arsenic alloyed by iron. It is generally found in cobalt mines, in Saxony, Bohemia, Norway.

b. *Native Oxyde of Arsenic*, White Oxyde of Arsenic; this is scarce, of a whitish colour, but exposed to heat becomes blackish. It is soluble in water assisted by heat; also in nitric acid, less so in muriatic and vitriolic acid. Found in Hungary, on the Hartz, in Bohemia, and Transylvania.

c. *Sulphuret of Arsenic*, Sulphurised Arsenic, Realgar, yellow Orpiment; of a yellow brimstone colour, inclining to orange; it's texture usually lamellar, and so soft as to be cut with a knife, and
a little

a little flexible; often of a beautiful brilliant lustre, which is improved by the scarlet red shades. When reduced to powder, it is used as a pigment. Found in Hungary, and other places. *Anal.* Arsenic 84,90. Sulphur 16,10. *Kirwan.*

d. *Red Sulphurized Arsenic*, or Ruby Arsenic; of an aurora colour; contains a larger proportion of sulphur than the preceding; common in China, where it is made into vases, pagodas and other ornamental works. Red arsenic is commonly found near volcanos, as at the Solfatara near Naples, &c.; it's matrix is quartz, heavy spar, and ferruginous clay.

e. *Mispickel*, Pyritical Arsenical Ore, Arsenical Mundick; arsenic and iron mineralised by sulphur; sometimes combined with silver; it is found in cubes, rhomboidal, four-sided, truncated prisms, sometimes terminating in dihedral summits, with triangular plans; octohedral; the surface is generally striated. When enclosed in a close vessel, it sublimes and forms orpiment, leaving the iron behind. It's matrix is spathose iron ore, fluor, quartz, blende. Found in Saxony, Bohemia, Tuscany, and on the Hartz.

D. COBALT.

COBALT is seven times heavier than water, of a rose-white colour, brittle and easily reducible to powder; is a little moveable by the magnet, probably from some iron it contains; difficult of fusion; when fused with sand and potash, it forms smalts,

smalts, used for blueing clothes. Is soluble in nitric acid without heat, and in vitriolic acid assisted by heat; likewise in the marine and nitro-muriatic acid, which diluted with water, is used for sympathetic ink.

a. *Grey Cobalt Ore*, Arsenicated Cobalt; chiefly composed of cobalt and arsenic; of a fine-grained, compact texture; of a steel-grey colour. Found in Saxony, Bohemia, Norway, in a matrix of red heavy spar; calcareous quartz.

b. *White Cobalt Ore*, consists of cobalt and iron, mineralised by sulphur and arsenic, of a tin-white colour, of a granular and lamellated texture. Found in Norway and Sweden.

c. *Sulphuret of Cobalt*; contains no arsenic or iron; when heated it emits a sulphureous smell; found in cubical crystals in Upper Hungary, generally upon quartz.

d. *Native Oxyde of Cobalt*; Black Oxyde or Calx of Cobalt; this is the purest kind of the calciform cobalt ores; when heated, it emits no sulphureous or arsenical vapours. Found in Thuringia, Saxony, Tyrol. Of the oxydes of cobalt there are various species, as *Brown earthy Oxyde*, *Yellow Oxyde*, *Green Oxyde*, *Red Oxyde*, of Cobalt.

X

N. ZINC.

N. ZINC.

ZINC is about 7 times heavier than water; it is soluble in the nitric, sulphuric, and muriatic acids, and produces by the two last hydrogen gas or inflammable air; it burns with a bluish green flame when exposed to red heat, and sublimes in the state of a white light substance; it precipitates lead and other metals, in a metallic state, from their solution. When in an oxyde state, is recovered by charcoal in a close vessel. It is found in various parts of Europe, never in a perfect metallic state, but generally in the state of calx or oxydated; frequently also combined with iron and sulphur. It is of a fibrous texture, and of a bluish grey colour.

a. *Native Oxyde of Zinc*, calamine, calx of zinc. *Anal.* Oxyde of zinc, 84. Oxyde of iron 3. Silix 12. Argill 1. *Bergman.*

Synonymous Names.

b. *Carbonate of Zinc*, { Chalk of Zinc.
Aërated Zinc.
Mephite of Zinc.

Oxyde or Calx of Zinc, combined with, or mineralised by fixed air or carbonic acid. Is perfectly soluble in sulphuric acid, without emitting heat; the fixed air is discovered by the effervescence which takes place when dissolved in the sulphuric acid, and the zinc combining with the acid, forms

c. *Sulphate*

Synonymous Names.

c. *Sulphate of Zinc*, {
 Vitriol of Zinc.
 White Vitriol.
 Vitriol of Goslar.
 White Copperas.

soluble in water; formed from blende, acidified by the absorption of oxygen, and thus producing the sulphuric acid, which afterwards combining with the calx of zinc, composes the Sulphate or Vitriol of Zinc. *Anal.* Zinc 20. Sulphuric acid 40. Water 40. *Bergman.*

d. *Blende*, or Sulphurized Zinc; combined with sulphur, iron, copper, filix. It is of various colours, sometimes resembling galena, and hence called pseudo-galena; when of a blackish colour, it is called *blackjack*. *Blende*, in the German, signifies blinding or deceitful. *Anal.* Zinc 52. Sulphur 26. Iron 8. Copper 4. Silix 6. Water 4. *Bergman.*

O. ANTIMONY.

ANTIMONY is about 7 times heavier than water; soluble in aqua regia, and precipitated by pure water; scarcely soluble in sulphuric or nitric acid; with muriatic acid it forms butter of antimony.

It is found in nature in the metallic state; in the state of calx, mineralised by arsenic, but most generally with sulphur, called crude antimony. It is of a bluish colour, of a lamellated and radiated texture.

X 2

a. *Native*

a. *Native Antimony*, usually mixed with iron and arsenic. It contains so large a proportion of the latter, that by fusion with sulphur, the product resembles realgar, or red arsenic; found in Dauphiny, Sweden; Saxony.

b. *Arsenicated Antimony*, Native arsenical Antimony; of a white brilliant lustre, and scaly texture; when heated, it emits only arsenical vapours. *Anal.* Antimony alloyed by arsenic.

c. *Muriate of Antimony*, White antimonial Ore; combined with muriatic acid, of a greyish white colour, found in oblong, rectangular, four-sided laminae. It is scarce; found near Braunsdorf, Freiberg, Bohemia; generally accompanied by red blende, galena, grey antimony.

d. *Red Antimonial Ore*; consisting of antimony, sulphur, and arsenic; of a light crimson red colour, in hexahedral, prismatic, capillary crystals; found in the antimonial mines of Bohemia, Hungary, and Transylvania.

e. *Sulphuret of Antimony*; Sulphurised Antimony; of a beautiful appearance of the rainbow colours; filaments long, in hexahedral prisms, with obtuse tetrahedral prisms; it is extremely scarce; it was found in a certain antimonial mine of Hungary, in quartz and heavy spar. *Anal.* Antimony 74. Sulphur 26. *Bergman.*

f. *Plumose Antimonial Ore*, or Argentiferous antimonial

antimonial Ore; antimony combined with iron, arsenic, sulphur, and sometimes silver; of a lead-grey colour; crystallized in slender prismatic needles. It is found near Freiberg, in Hungary and Tuscany.

P. MANGANESE.

MANGANESE is about 7 times heavier than water; soluble in marine acid; the solution appears brown; by addition of marine acid to manganese, is produced an elastic fluid or gas, called superoxygenated muriatic gas, or dephlogisticated muriatic acid air. When exposed to red heat in a close vessel, pure air is produced. It is usually found in the state of calx, or combined with oxygen. Next to iron and gold, it is the most frequently diffused metallic substance through the earth, and even in vegetables. Soluble in acids, and precipitated in a white powder by alkali.

a. *Native Manganese*; found in the state of greyish-white small globules, which, on exposure to the atmosphere, fall to a black powder.

b. *Native Oxyde of Manganese*, White oxydated Manganese; crystallized in tetrahedral rhomboidal prisms; found in Hungary, Transylvania, mixed with flint, and constitutes the matrix of the auriferous ores. *Anal.* Oxyde of Manganese 43. Oxyde of Iron 43. Lead $4\frac{1}{2}$. Mica 5. *Wedge-wood.*

c. *Black*

c. *Black calciform Manganese*, Black-Wad; of a greyish, or iron-black colour; found in Kőnitz, Piedmont, Carinthia, Thuringia, England, and Ireland.

d. *Siliceous Ore of Manganese*; of a steel-grey colour, and lamellated texture; combined with oxyde of manganese 35. Silex 55. Iron 5; and argill 5.

Q. SCHEELE.

SCHEELE, *Wolfram*, or *Tungsten*; of a greyish white, or yellowish colour; granulated, friable; is never found in the metallic state, but alone in the state of calx, combined chiefly with calcareous earth, manganese and iron; it's oxyde is of an acid nature, of a yellow colour, and enters into combination with all metals; it is soluble in the sulphuric, nitric, muriatic, and nitro-muriatic acids, and is converted by them into an oxyde, which combines also with alkalis; but is precipitated again from them by nitric acid. With the muriatic acid, the oxyde assumes a blue colour.

a. *Tunstate of Lime**, Sparry Tunstate of Lime, Tungsten; combined with Tungstenic acid 44; and lime 56; of a lamellar texture; greyish white colour; crystallized in angular octohedrons, or double tetrahedral pyramids; is 6 times hea-

* Salt formed by the combination of the Tunstic acid with different bases.

vier than water; digested with muriatic acid, it turns yellow; found in Bohemia and the tin mines in Cornwall.

b. *Wolfram*, Manganeseous Wolfram; combined with tungstenic acid 64; oxyde of manganese 22; oxyde of iron 13; filix and tin 2; of a dark black colour; lamellated, brittle, crystallized in compressed hexahedral prisms, terminated with tetrahedral pyramids; found in England, Siberia, Bohemia, Saxony.

R. URANITE.

URANITE, or Uranium; is of a deep-grey colour, with a slight lustre; above 6 times heavier than water; is soft enough to be cut with a knife; soluble in nitric, sulphuric, and marine acids; is not precipitated by zinc; phlogisticated alkali added to the solution, produces a deep red precipitate. First separated in 1790, by Klaproth, from the mineral called Pechblende. Found in a state of calx or oxyde, and mineralised by sulphur.

a. *Carbonate of Uranite*; Calciform or Oxyde of Uranite, or Calcolite. The earthy oxyde of uranite is a variety of an earthy texture; of a brimstone yellow; it is found solid, dispersed through, and deposited upon other ores. The variety called spathose uranite, is of a grass-green colour, and generally found crystallized in cubes, and in hexahedral prisms; consists of uranium, carbonic

carbonic acid, and a little copper; found in Bohemia.

b. *Sulphuret of Uranite*; Sulphurated Uranite, Pechblende; of an iron colour, brittle texture; emits a sulphureous smell exposed to heat.

S. MOLYBDENA.

MOLYBDENA, is of a steel-grey colour, very brittle; 6 times heavier than water; is only found in nature combined with sulphur. It melts easily; is volatile by moderate heat, effervesces with alkali; emits a sulphureous smell when treated with the blowpipe.

a. *Sulphurised Molybdena*, or Molybdena mineralised by sulphur; consisting of the molybdic acid and sulphur; its matrix is felspar, lithomarge, and quartz; found in Iceland, Sweden, Spain, Saxony, France, Siberia; frequently in rocks containing wolfram and tin ores.

T. MENACHANITE.

MENACHANITE, discovered in the valley of Menachan, in Cornwall, by Mr. Gregor; and supposed to constitute a new metallic substance.

a. *Native Menachanite*; Menachanite alloyed by iron; found amorphous, or in grains, and in irregular forms; of a grey, or dark colour; ponderous, and attractable by the magnet.

U. SYL-

U. SYLVANITE.

This semi-metal, discovered by *Facebay*, is different from all other known metallic substances; and is called *Sylvanite* from it's being found in *Transylvania*; of a metallic lustre; fracture broad, or granularly imbedded; of a dark-grey or white colour; resembles *regulus of antimony*, or *sulphurated bismuth*; evaporates by continued heat; amalgamates with *mercury* by simple trituration; and detonates with *nitre*; soluble in *aqua regia*, and in concentrated *vitriolic acid* in cold, or a low digesting heat, and the solution is crimson red; but by the affusion of water, or by a strong heat it is precipitated. *Muller* found it to contain a small proportion of *arsenic* and of *nickel*, and also of *gold*. *Bergman* found it to contain a little *zinc*; but these mixtures seem to be merely casual. *Kirwan*.

V. TITANITE.

A semi-metal, discovered by *Klaproth*, found at *Rhonitz*, and at *Bainick* in *Hungary*; of a brownish-red colour; fracture foliated, unequal and conchoidal; crystallized in right-angled quadrangular prisms, longitudinally streaked and furrowed, often acicular, and seated on *schistose mica* alternating with *quartz*. Exposed to a moderate heat, it remains unaltered, but in a cool crucible it bursts into angular fragments, loses it's lustre and colour, and becomes pale brown; insoluble in *aqua regia*, *vitriolic*, *nitrous*, or *marine acid*.

Y

a. *Calcareo*

a. *Calcareo Siliceous Ore*; found near Passau; discovered and described by Professor Hunger; of a reddish, yellowish, or blackish-brown colour; found massive or disseminated; but more frequently crystallized in obtuse-angled tetrahedral crystals; found seated on, or inhering in gneiss or granite; foliated or striated; cuts glass. *Kirwan.*
Anal. Silica 35. Calcareous earth 33. Titanitic calx 33. *Klaproth.*

W. CHROME.

CHROME, so called from it's property of colouring the combinations into which it enters; discovered by Klaproth in the red lead of Siberia. Vauquelin has made many experiments upon this substance, but it's place in mineralogy is not yet fully established.

X. TELLURIUM.

Klaproth has chemically analyzed the auriferous mine, known as the mine of white gold (*Weisse goldertz*) *aurum paradoxum*, *metallum vel aurum problematicum*; found in the mine called Maria-lulf, in the mountain of Fatzbay near Zalethna, in Transylvania; and in this mineral has found a metal different from every other yet known.

It is of a whitish greyish colour; friable and lamellar; in cooling after being heated, it takes a crystallized surface; very hard of fusion. Placed on a heated body, it burns with a bright flame, of a blue colour; it amalgamates with mercury.

It's

It's solution in the nitrous acid is clear and colourless; when it is concentrated, it exhibits pointed needle-like crystals.

The pure alkali precipitates from the acid solutions of it, an oxyde of a white colour, soluble in all the acids.

The ore of white gold of Fatzbay, aurum vel metallum problematicum, contains: *Anal.* Metal of Tellurium 925,5. Iron 72,0. Gold 2,5. Total 1000.

The graphic gold of Offenbanya, contains Tellurium 60. Gold 30. Silver 10. Total 100.

The mineral known under the name of the *Yellow Ore of Nagyag*, contains Tellurium 45. Gold 27. Lead 19,5. Silver 8,5. Sulphur scarcely an atom. Total 100,0.

The *Foliated grey Gold of Nagyag*, contains Lead 50. Tellurium 33. Silver 8,5. Sulphur 7,5. Silver and Copper 1. Total 100,0.

CLASS IV.

INFLAMMABLES.

INFLAMMATION, or combustion, consists in the fixation and absorption of vital air by combustible bodies, and in the decomposition of atmospheric air by these bodies. As vital air is a gas, and many combustible bodies, by absorbing, fix it, and make it take a solid form; hence vital air, when thus precipitated, will lose the caloric to which it owed its elastic fluidity; and hence comes that free caloric or heat, which is evolved during combustion.

I. AERIFORM.

A. *Hydrogen,*

Is one of the component principles of water; and in combination with caloric and light, forms hydrogen gas.

a. *Pure Hydrogen,* exists always in a state of gas. It is a constituent of water; where it forms one sixth. It is distinguished from all other gases,
on

on account of it's being inflammable; hence it is called inflammable air. See §. V. page

b. *Sulphurated Hydrogen, Hepatic Gas*, is obtained from livers of sulphur, or sulphures, by decomposing them with acids. Sulphur combines with hydrogen gas, called sulphuret, or hydrogen gas, or sulphurated hydrogen gas, or hepatic air.

II. SIMPLE BITUMINOUS SUBSTANCES.

Bituminous substances are not of mineral origin, but have been formed from certain principles of substances belonging to the organised kingdoms of nature; which, after the loss of animal and vegetable life, have suffered considerable changes, by long contact and union with mineral bodies; and may hence be regarded as forming a part of the mineral system.

a. *Naptha*, is a light, thin, often colourless oil, highly odoriferous and inflammable, which in some parts of Persia and Italy is found upon the surface of springs and lakes, and issuing from argillaceous stones; does not combine with water or spirit of wine; when burned, leaves a black soot; acids condense it and render it resinous: when first exposed to the air, it becomes yellow; afterwards, and in like proportion, it thickens, and passes into

b. *Petroleum, or Rock Oil*; and seems chiefly to differ from *Naptha* in being mixed with heterogeneous

geneous matter; it is found in various parts of Europe trickling from the fissures of rocks. It has a greasy feel, is transparent, or semi-transparent, of a reddish or blackish-brown colour; by air it becomes like tar, and then is called

c. *Mountain or Mineral Tar, Barbadoes Tar, Bitumen Petroleum tardefluens.* It is viscid; of a reddish or blackish-brown or black; when burned it emits a disagreeable bituminous smell, and by exposure to the air, it passes into

d. *Mountain or Mineral Pitch, Bitumen Maltha;* which is more impure than petroleum; it has the consistence of honey; is of a brownish-black colour; frequently mixed with much earthy matter, resembles common pitch; when heated emits a strong unpleasant odour, like the former substance; in cold weather it may be broken, and exhibits internally a glossy lustre; when warmed it softens and possesses some tenacity. It is however susceptible of a superior degree of induration, and then becomes *asphaltum*.

e. *Asphaltum, or Bitumen of Judea,* has derived its name from the Dead Sea of Judea, upon the surface of which it is found, and upon the shore. It is met with also in other countries. It is smooth, of a black colour, and shining conchoidal fracture.

III. COMPOUND BITUMINOUS SUBSTANCES.

Mr. Hatchett, whose division of bituminous substances I have chiefly followed, is of opinion that the progressive changes of naphtha into petroleum, mineral tar, mineral pitch, and asphaltum, is caused by the gradual dissipation of part of the hydrogen of the bitumen, and the consequent disengagement of carbon; and although the division of the simple bituminous substances terminates in asphaltum, nature appears to have glided on by an uninterrupted chain, which connects the simple bitumens with the compounds.

a. *Jet*, is a compact black body; harder and less brittle than asphaltum; may be formed into trinkets; it breaks with a conchoidal fracture, and the internal lustre is glossy. It has no odour, unless when heated, and it then resembles asphaltum.

b. *Coal*, of which carbon is a constituent principle, is found in various parts of Europe in strata beneath the surface of the earth; it is foliated, brittle, black, and glittering. Besides carbon, it's constituent parts are, petroleum, maltha, and asphaltum, combined more or less with other earthy particles, and, frequently with sulphur, and the remains of vegetable matter.

c. *Mineral Elastic Gum*; discovered in 1786,
near

near Castleton, in Derbyshire; resembles, in colour and elasticity, caout-chou, or Indian rubber; formed from naptha or petroleum; there are many varieties; some in the state of asphaltum, by making lose their elastic property, and a quantity of gas is disengaged; and the substance remaining resembles mineral pitch, or mineral tar.

B. AMBER is one of the purest bitumens, consisting almost entirely of a volatile oil, which receives it's consistence from a peculiar acid (succinic) and of a few earthy and coaly particles.

Amber has been chiefly procured on the shores of the Baltic. The yellow amber of Kœnigsberg has been lately discovered by digging. It is raised 200 feet from the sea, where many shafts are sunk, one of which is near 100 feet in depth. The amber does not run in veins, but is found in nodules, in a matrix of charcoal, below which there are strata of sand. In the charcoal there are sometimes little threads of amber. This seems to shew that the origin was volcanic, and that the amber was accumulated by sublimation.

a. *Honeystone*; crystallized in aluminiform octohedra; found in Thuringia, between beds of bituminous wood, and is sometimes near an inch in diameter; it is crystallized in great masses, in a double pyramidal form, with four sides; it bears a great resemblance to amber, but does not, like that substance, become electric by rubbing; by Mr. Abich's analysis it appears, that 50 parts of this fossil are composed of 8 parts of the carbonate of

of alum, 2 of carbon, $1\frac{1}{2}$ of oxyde of iron, 20 of carbonic acid, 14 of the water of crytallization, emitting the smell of bitter almonds, and $2\frac{1}{4}$ of ether; with a small portion of the benzoic acid. In consequence of the incombustibility of the honey-stone, he proposes to exclude it from the class of combustible bodies, and to place it among that of aluminous earths.

b. *Common Amber* is found in several countries of Europe beneath the surface of the earth, among clay, sand, and the iron bog-ore, but most abundantly in the sea, and particularly on the shore of the Baltic; found in masses, irregular, transparent or opaque, of a white, yellow, or brown colour; red and green amber being scarce. Tasteless; of a faint odour when rubbed, and becomes electric; insoluble in water.

C. MINERAL TALLOW, or MUMIA; found in 1736, in the sea, on the coast of Finland; also in some rocky parts of Persia, mixed with petroleum. It is perfectly white, of the consistence of tallow, but more brittle though as greasy; it burns with a blue flame, and a smell of grease, leaving a black viscid matter, which is more difficultly consumed.

D. SULPHUR is a simple body, which, during combustion, or, in other words, during it's combination with oxygen, produces sulphuric acid. Sulphur is found near the craters of volcanos, and the sources of some mineral waters.

Z

a. *Common*

a. *Common, or Native Sulphur*, is a yellowish substance, odorate, electric, transparent, and octohedral; opaque and prismatic; fusible, and subject to different combustions; one is slow, with a bluish flame, and yields sulphureous acid; the other rapid, with a white flame, and yields sulphuric acid.

b. *Volcanic Sulphur*; amorphous, granular, compact.

E. PLUMBAGO, or Carbure of Iron; or iron combined with a large portion of carbon.

a. *Common Plumbago; Graphite*; this substance has not yet been produced by art, but nature contains it in considerable abundance; suffers no change by water or atmospheric air, nor exposed to fire in close vessels; but burns slowly, if heated, in contact with air; amorphous, fibrous and flaty; of a deep iron black colour; little shining, metallic lustre, stains the fingers, soapy to the touch.

b. *Anthracolith*; consisting of Carbon 90. Argill 5. Iron 3. *Born.*

VOLCANIC

VOLCANIC PRODUCTIONS.

I. CINDERS.

A. LOOSE.

a. *Ashes*, of a brownish or reddish grey colour; consistence loose and dusty; very light and subtle, and smooth to the touch; slowly diffusible in water, and when wet, somewhat ductile; effervesce slightly with acids; and contain about half their weight of argill, a small proportion of earth, calx, magnesia, and iron, and the remainder is siliceous.

b. *Sand*; consisting of minute hard grains, that readily sink in water; generally fragments of lava and scoriæ, together with olivia, garnets, felspar, and schorl.

B. COHERENT.

a. *Puzzolana*; colour reddish brown, grey, or greyish black; that of Naples grey; that of Civita Vecchia, reddish brown; surface rough, uneven, and of a baked appearance; pieces of various sizes, from the size of a nut to that of an

Z 2

egg;

egg; fracture uneven, or earthy, and porous; commonly filled with particles of pumice, quartz, scoriæ, &c.; very brittle; does not effervesce with acids; magnetic before it is heated, but not after; contains filix, argill, and iron.

b. *Trass*, or *Terras*; resembles puzzolana; though often the product of pseudo volcanos, or external fires; colour greyish brown, or yellowish; surface rough and porous; fracture earthy, rarely lamellar; found principally near Andernach, in the vicinity of the Rhine; also near Frankfort, Cologne, Pleith, &c.; and there called Duffstein; containing fragments of argillite and basaltine, often branches of trees half cleared, and impressions of leaves, with mica, iron ore, &c.

c. *Tafa*; a kind of puzzolana formed by nature into a mortar; colour brown, or reddish brown, brick red, or speckled with various colours; fracture earthy; contains sand, scoriæ, fragments of lava, limestone and pumice; often basaltines and Vesuvian; commonly magnetic, and not easily decomposed by the action of the ore.

d. *Pumice*; colour grey, rarely brown, or blackened by fuliginous fumes; surface rough and fibrous, with elongated pores; sometimes fibres not discernible; fracture striated and open, uneven and splintery; fragments oblong, obtuse, and irregular; brittle in a high degree; fusible at 130. Q. into a grey slag.

e. *Piperino*;

c. *Piperino*; a concretion of volcanic ashes, and is said to be the substance that covers Pompeia; colour grey or reddish brown; fracture earthy; contains fragments of white marble, felspar, mica, garnets, scoriae, gypsum, schorl, granite, &c. sometimes magnetic; if preserved from moisture, it hardens in the air.

II. LAVA.

Any matter that has issued out of a volcano in a liquified state, or that has accompanied or been enveloped in such liquified matter. *Kirwan*.

a. *Cellular*; colour brown, or greyish black; surface unequal, rough, and full of cavities; affects the magnetic needle.

b. *Compact*; earthy substance, or matter, which, after having been fused, but not vitrified, becomes, on cooling, compact, close, and solid.

III. VITREOUS LAVAS.

a. *Glass*; such matter as has been exposed to the greatest heat, and from the composition, most susceptible of vitrification in a moderate heat; colour black, green, yellow, or greyish white; found in detached masses; either spongy or compact fracture.

b. *Enamel*; resembling vitreous lavas, is the imperfect vitrification called enamel; colour white,

white, grey, or brown, often with round spots, of a different colour from the ground; sometimes contains crystals of schorl, or felspar, not completely melted; fracture rather more granular than that of glass.

c. *Scoriæ*; compounded of iron and stony matter, and owe their fusion to sulphurated iron; they are tumefied and expanded by the sulphureous vapours; colour generally black; sometimes reddish from the calcination of the iron; surface rough, and uneven; texture cavernous; the cavities larger and more irregular than those of cellular lava, but never fibrous.

d. *Slaggs*, resemble the dross of forges, generally red and heavy.

**NATURALIST's and TRAVELLER's
COMPANION, &c.**

PART the SECOND.

ALTHOUGH it may be admitted with peculiar honour to the present age, that the knowledge of natural history and of science in general has been of late considerably enlarged; yet as the objects of human inquiry are numberless, and frequently dispersed in distant parts of the globe, as well as complicated in their history, the sentiments of an ancient philosopher may be adopted even at this day with propriety: "Multa etenim
" sunt quæ esse audivimus, qualia autem sint ig-
" noremus! Quamque multa venientis ævi popu-
" lus, ignota nobis, sciet*!"

At the same time if we reflect upon the foregoing suggestion, respecting the amazing progress made in natural history within the space of a few years, we may find sufficient inducement to persevere in pursuits so worthy of a rational mind.

* Seneca.

It would render natural history much more pleasing, as well as greatly tend to it's progress, were the limits of our knowledge therein precisely ascertained, that travellers and curious persons, who have little leisure for reading, might not only be informed of what is already discovered, but also of what is still doubted, or unknown; by which means their inquiries would be better directed, and more conducive to real information and useful discovery.

SECT. I.

*Observations and Queries respecting Learning,
Antiquities, religious Rites, polite Arts, &c.*

Ingenuous arts, where they an entrance find,
Soften the manners, and subdue the mind*.

1. **T**HE alphabets of the various nations, their pronunciation and numeric value, with their numeric figures, if different from the letters of the alphabet, and books written in each language, especially grammars, dictionaries, &c. with the dates of each when written, merit the investigation of the curious; likewise the materials used for writing, and their preparation, as the methods of making ink, paper, and pens, and of fizing and gluing the paper; the art of printing, and the contrivances for doing it.

2. Manuscripts, in good preservation, of the Hebrew Bible, or parts thereof, particularly if upwards of 300 years old.

3. Books containing the religious principles of any nation or people, and which usually are written in a dialect different from that which such people now speak, or in a poetical, high metaphorical style, and therefore understood by few only, and for the most part kept very secret;

* ——— Ingenuas didicisse fideliter artes.

Emollit mores, nec finit esse feros.

OVID. Pont.

A a

amongst

amongst these we may enumerate the Chartah Bhade Shattah of Biamah, the Chartah Bhade and Aughtorrah Bhade Shattah, the Vedam*, the sacred books of the Persees, written in the ancient Persian dialects, called the Zend, and Pehlvi†; the Koran of Mahomet; the sacred books of the Mendæans or Sabaites, at or near Bassora in the Persian gulph; the voluminous sacred books of the Lamas in Nexpal and Thibet, called Khangjur, and it's mystic part, termed Riuté; the sacred books of the priests in Pegu and Siam, and others of similar tendency. These would be still more valuable, could English, Latin, or French translations be added.

4. Descriptions of the manners, customs, feasts, and religious ceremonies of the respective nations; the architecture both exterior and interior of their temples, religious, public, and private buildings; the figures, names, genealogies and ranks of their divinities and idols; their sacred and domestic utensils, the casts and ranks of people, the learning and religious tenets of each nation, to all which explanatory drawings would be required. What nations use circumcision, and what are the advantages derived from such a custom, or disadvantages from the omission of it? Is circumcision ever extended to the females, and in what manner is it employed?

* In the peninsula on this side the Ganges, the sacred books of the Bramins are contained in the Vedam, copies of which, in the original Sanscrit character, would be very valuable.

† The Pehlvi is a more modern dialect.

5. The

5. The translations of the Bible in different languages; and the sacred books of Christians of various denominations; as the Georgian, Armenian, Persian, Æthiopian, Coptic, Arabic, and Syriac, especially among the Christians on the Malabar coast, and in the isle of Socatora*.

6. The history and succession of princes, the origin and migration of nations; the government and political constitution of each country; the causes of the increase or decay of power.

7. A relation of the private and domestic life of the people; the customs observed at the birth of children; the marriages, sepulchral rites, and any other circumstances characterising each nation.

8. An account of the astronomy and chronology of different nations, whether they observe the system of the seven days of the week, the names for these days, with their signification. The number, names, and significations of their months; the number of these in a year; whether they are used to conciliate the moon's and sun's motion by any intercalation, or a certain cyclus of years; the names for particular stars and constellations in the zodiac, with their significations; the distinctions of the other stars from the planets, with the length of their revolutions.

The state in which the art of drawing, carv-

* The Nestorian Christians formerly had a settlement among the Indians on the Malabar coast, and were there very much respected. Are some of these still existing? Have they any ancient Syriac books?

ing, and engraving in stone has been, or now is. Specimens, drawings, or collections of old inscriptions, engravings, seals, gems, statues, carvings, basso and alto relievos, and the places where each of the above monuments are found, the size, substance whereon it is worked, &c. the ancient and current coin, with the exact valuation.

SECT. II.

Commerce, Manufactures, Arts, Trade, &c.

Jove has the realms of earth in vain
Divided by th' inhabitable main:
If ships profane, with fearless pride,
Bound o'er the inviolable tide*.

FRANCIS.

DESCRPTIONS and drawings of the looms, tools, machines, &c. employed in manufactures, particularly if simple, ingenious, and gaining time or strongly increasing power, might prove highly beneficial.

2. An account of the planting, gardening, and agriculture of each country; the manure used, the time and labour employed in each branch of business; the price of labour, the implements of agriculture; the kinds and quantities of corn sown in an acre; the quantities reaped in different soils; the proportion of vineyards or pasture lands to arable, and the number of people in a square mile of pasture, arable lands, vineyards, or any other kind of plantation.

3. The kinds of pigments, stains, and dying materials known and used, particularly in China;

* Nequicquam Deus abscondit
Prudens oceano dissociabile
Terras, si tamen impie
Non tangenda rates transiliunt vada.

HOR, l. 1. Od. 3.

are

are they mineral or vegetable? the manner of preparing and applying them, with the advantages and disadvantages of each sort compared with ours; particularly the materials, machines and methods employed by the Indians for dying, staining, and printing their chintzes, calicoes, &c.

4. The wood and timber used for ship building; the form and construction of the ships; the wood employed for masts; the succedanea for oakum, ropes, cables, sails, pulleys, &c. with the comparative advantages and disadvantages.

5. The means devised for catching quadrupeds, birds, fishes, shells, &c. either for food, or to prevent the increase of such as are noxious to the people or their plantations; are any animals made tame and employed to catch others, or are any methods used for killing or inebriating them?

6. The materials of clothing; if animal skins, the manner of dressing them; if the hair of animals, or the threads of certain insects, the method of spinning, twisting and weaving such substances; if vegetables, how are they cultivated, dressed, spun, and manufactured? The cut and make of the dresses in general, with the advantages and disadvantages of each particular part.

7. The various objects of commerce in general, the growth and manufacture of each article, with the names by which it is known, and its uses, when designed only for inland trade; the price of labour, and the number of people employed in each department.

8. It is a common opinion, that large quantities of remnants and rags of all kinds of scarlet cloth,

cloth, are yearly carried from England to China, and that the Chinese extract from them their fine red pigments. If this be true, what methods are employed to extract the colour?

9. It has been observed that analogous substances are most proper for dying homogenous bodies*; thus animal substances are best for dying wool and silk, because wool and silk are animal substances. A blue dye, made of woad (*Isatis* of Linnæus) is found to be full of insects. Is it not the same case with indigo? Are not all the lasting dyes made from animal substances, or of such as contain numerous insects?

10. The manner in which the best indigo is manufactured in the interior parts of Indostan, and the plant from which it is made. Is it from the *Indigofera* or the *Anil*? Are there any rules to ascertain when the plant has soaked sufficiently, and how long it ought to be beaten?

11. Is there any linen made of flax or hemp, or what other substances are spun and wove in India besides cotton? What use is made of the yellow or brown cotton taken from the *Bombax*? Is it manufactured for apparel, and appropriated for a certain order of men, as priests or Bramins?

12. Descriptions and drawings of the instruments and machines employed by the Chinese and Indians to clean the cotton from the seeds.

13. Is only European zaffer from cobalt used by the Chinese for painting their porcelain blue, or have they some of their own? If they have,

* Vid. *Histoire de l'Academie*, an. 1768. art. 11.

what

what name is it known by, and how is it manufactured? It is probably finer than ours, from the richness of the old China figures.

14. The preparation of the pickle or catchup called Soya; is it made from the *Dolichos Soya* Linn.? Is salt, wheat or barley added, and in what proportions?

SECT.

SECT. III.

Metereological Observations, Food, Way of Living, Animal Economy in general, &c.

For every man to native custom prone,
Conforms and models life to that alone.

GOLDSMITH.

IT is always satisfactory to have regular meteorological accounts by the assistance of a good barometer and thermometer; and to observe at the same time the quarter the wind blows from, and it's degree or violence; the quantity of rain and snow by inches; the size of hailstones; the appearance of ærial phenomena, as aurora borealis, or northern lights, fiery globes, halos or bright circles round the sun and moon; with the effects likewise of thunder storms, lightning, &c.

2. The traveller should also remark the succession of seasons, and the various fruits and productions of each country; the times of sowing or planting, as well as of harvest, or of reaping the grain, &c. the budding or flowering of trees, or shrubs. The food of the inhabitants, and the preparation of it previous to it's use.

3. Some account might be collected of the general prevailing diseases in different seasons, and the causes producing the same, or the remedies employed for curing them, and the methods in which remedies are administered.

B b

4. Are

4. Are any diseases caused by the effluvia of certain trees or plants, or is the touching, handling or cutting of trees or plants ever suddenly prejudicial to health? Does the effluvia from spice trees or the frankincense tree prove deleterious?

5. What are the effects or symptoms which arise from the bite of poisonous snakes, or any reptile or insect? Has the bite of a snake ever been found to have a salutary effect in curing a certain previous disease, or does the bite of one snake ever destroy the effects of another? Are there any counterpoisons or antidotes usual against the bite of snakes? Is musk or any species of the aristolochias a remedy which the snakes avoid and fly from, or do any of these prove lethal to snakes?

6. Is the *pedra de cobra* used as an antidote against the effects of the bite of any snake, and with what success? How is this remedy procured and applied?

7. The manner of managing domestic animals, whether in health or otherwise. The animals which the natives in any country castrate, and the effects produced by it; as well as the period when such a custom was first introduced.

8. It would deserve remarking where and in what manner polygamy is introduced, whether perpetual or temporary, and the effects of it upon the manners, religious or civil customs, population, &c. of such countries. Does polygamy prevent some men from procuring wives, or are the women brought from neighbouring nations? Is it any

any where customary for one woman to be married to several husbands during the life of the first?

9. Accurate calculations of births or burials in provinces or towns, and the proportions of males to females, would prove very valuable.

10. Have any buildings or ships, furnished with electrical rods after Dr. Franklin's method, ever received any injury from lightning?

11. Is the venereal disease cured without mercury? and if so, by what remedies?

12. What diseases attack the workmen employed in different kinds of manufactories?

SECT. IV.

Zoology.

Non ad unam naturam formam opus suum prestat; sed in ipsa
varietate se jactat.

SENECA Quæst.

1. **I**T would greatly tend to improve our knowledge in this department of natural history, were the following remarks respecting quadrupeds to be carefully made; viz. the general times of coupling and of gestation; how many young are brought forth at a time, and how often during one season; at what period of life they become prolific or barren: where their principal resort and dens are; whether the males assist the dams in providing food for the young of the carnivorous tribe; how long these are under the protection of the old ones; and what age each species attains?

2. It might be inquired whether any person hath ever seen elephants in copulation, which has been hitherto denied; it is said that if the wild elephants perceive any body, they immediately begin to rave, and cease not till the curiosity of that person has been rewarded with death; and though the Indian princes have kept great numbers of tame elephants of both sexes, they never could procure a breed from them. What differences are there betwixt the African and Indian

Indian elephants? Is the structure of the grinding teeth equal or flat in all, or have some elevated or pointed crowns, similar to those of carnivorous animals? Do elephants ever shed their tusks or teeth, or are they permanent?

3. How many species of tigers, so called, or more properly of leopards, panthers, ounces, &c, are there in India, and what are the stated and perpetual marks for distinguishing each, in different periods of life? What other animals of the feline kind are found in India, with the specific characters of each?

4. Does the shakal, or jackal, (*canis aureus* Lin.) bear any resemblance to an animal commonly called the cross-fox (Pennant's Syn. Quadr.) What animal do the Arabian writers call *banat-el-auvi*?

5. Are armadilloes (*dasypodes* Lin.) in Asia or Africa, in what parts, and what are their characteristics?

6. When the various species of the feathered tribe begin to couple or pair should be noticed; when, where, and of what materials each bird builds its nest, with the colour, size and number of eggs; how long the eggs are in incubation; what the young are fed with, and at what periods they are fledged; with the distinctions between male and female birds in different seasons and ages.

7. The migration of birds should not be disregarded; but their merely disappearing in one part of the country is not properly a migration, for we frequently find that birds shift their place of abode,

at

at certain seasons, on account of some palatable food, which may be more plentiful in one part than in another; the crossing wide seas or extensive continents is understood. If any bird be found out at sea, the species of bird, the direction of it's flight, the distance from land, and the latitude and longitude should be noted.

—————In figure wedge their way,
Intelligent of seasons; and set forth
Their airy caravan, high over seas
Flying, and over lands; with mutual wing
Easing their flight : so steers the prudent crane
Her annual voyage, borne on winds : the air
Floats as they pass, fann'd with unnumber'd plumes*.

In northern climates it would be useful to observe when swallows are first seen, and when they disappear; and likewise in what climates they have been found, whether in a torpid or active state, with the species and peculiar characters.

8. What birds or animals are allowed a privilege or immunity from being injured or killed? and what may be the reasons for the same, or the advantages derived therefrom?

9. Some birds of prey are employed in the east by the grandees in hawking and hunting. What means are used for teaching such birds, and what are their differences, size, figure, plumage, names, specific characters, &c.?

10. What are the character, plumage, food, and oeconomy of the Indian ravens (*buceros* Lin.)

11. Are there any humming birds (*trochilus*

* MILTON.

Lin.)

Lin.) in the Indies or China with a filiform long tongue, consisting of two semi-cylinders?

12. What are the peculiar distinctions of the true wild peacock? Are there any white peacocks in India, and of a separate species? Is the change in plumage obvious in wild peacocks, or is this the result of domestication? Do white peacocks breed with grey and green ones, and what is the colour of the young breed?

13. Is there to be found in the Indian seas a jaculator fish, *sciaena jaculatrix**, different from the *chætodon rostratus*, Linn.? or is the faculty of shooting at insects with a drop of water peculiar to these fish, or common to any others?

14. Has the rajah torpedo, Linn. or the cramp or numb-fish, the same electric qualities as the *gymnotus electricus*?

15. As there is yet wanted a good figure of the sea cow (*trichechus manatus* Lin.) it would be desirable to procure a good drawing of it while alive, to have it dissected, and to observe wherein it coincides with, or differs from other animals nearly related to it, as the seal, dolphin, &c.

16. The seasons should be noticed, when different species of fish spawn, and the rivers, bays, shoals, or sands they resort to for that purpose; what age they attain before they spawn, the food they eat, the age they live to as accurately as possible, the size they acquire, and the latitude wherein they are generally found; the method of catch-

* Philosophical Transactions, Vol. 54. and Vol. 56. t. 8. p. 186.

ing them, and to what uses also they are applied when caught, and whether they are esteemed wholesome food or the contrary?

17. Which species of moth is it, the caterpillar of which in China affords that strong grey kind of silk, and how is it manufactured or wove? How are these silkworms or caterpillars preserved, fed, and managed? The introduction of such a new silk into England would be a useful acquisition, and redeem entomology from the censure it is now branded with, of being a mere curiosity void of any real utility.

18. Are there any rattle-snakes in the Indies or China, or in any part of the world besides America?

19. The various bundles of swimming sea weeds ought not to be neglected; for besides the different kinds of fuci they consist of, they generally contain small crabs, shrimps, or other submarine insects or worms, such as the onisci, monoculi, sometimes shells and escharæ, fertulariæ, and other corallines.

20. The various animals inhabiting shells deserve investigation, as there are probably new genera yet to be discovered: it is not fully ascertained whether the inhabitant of the paper-nautilus be an animal really belonging to that shell, or only uses it in the same manner as some crabs do other shells; neither is it known whether or no the paper-nautilus animal, or the sepia, increases or enlarges it's shell. Indeed the generation, and general œconomy of all the mollusca class are very imperfectly known.

21. Experi-

21. Experiments might be tried to ascertain whether pearls are not such concretions in the shells wherein they are found, as the crabstones (*lapides seu oculi cancerorum*) in the shells of the river cray-fish, which collect alkaline or calcareous materials from the food of the animal for the formation of the new shell, as do the *mya* and *mytilus margaritifer* a new layer for the increase of their shells. Do the shells containing the pearls gradually increase through the year, or at a certain season only?

22. It should be carefully remarked which of the shells, especially of the *murex* and *turbo* kinds, afford a red or purple juice fit for staining or dying like the purple of the ancients; whether the dye be permanent, and the method of preparing and applying it by some Indian nations. D'Ulloa, in his *South-American Voyage*, Vol. I. page 182, speaks of one of these shells found near Panama on the Darien Isthmus; and Janus Plancus, or Giovanni Bianchi, in his work on shells, mentions the *turbo scalaris* Linn. or *wendeltrap*, as affording the violet purple of the Romans.

23. Descriptions and drawings of the animals or polypes inhabiting the various corals, coral-lines, sponges, echini, or sea-eggs, *asteriæ* or star fish, *sepia* or cuttle fish, *holothuriæ* or sea-nettles, and all the various mollusca, and the polypes of the tubipores, madrepores, millepores, cellepores, &c. deserve the attention of a natural historian, as but few of them are well described or known.

SECT. V.

Botany.

Itaque ista quoque naturæ rerum contemplatio, quamvis non
faciat medicum, aptiorem tamen medicinæ reddit.

Calsus.

1. **T**HE seeds of almost all the Indian plants
are worth collecting, they may be pre-
served in the manner described in sect. III.

2. What trees bear the myrobalans, a drug
formerly much in request, but at present in little
esteem as a medicine, but which might probably
afford some use in dying? What species of trees
bear the myrobalans bellirica, chebula, citrina,
and indica or nigra; whether a kind of phyllan-
thus as the myrobalanus emblica? The use also
of the same in India?

3. Is the aloe-wood or eagle-wood, the ca-
lambac, and the agallochus, the same or different?
The place from whence procured, with the gene-
ric and specific characters?

4. Is the orchel or rochel (lichen rocella,
Lin.) which is found in Madeira, and used to dye
red, a kind of lichen or a zoophyte? Is the
steeping it in putrid urine sufficient to prepare it?

5. Where does the lignum rhodium grow?
Is it a kind of nyctanthes or Indian jasmine?

6. Of what genus and species is the tea-wood,
of which tea-chests are made?

7. What

7. What is the wood tek on the Malabar coast, of which the Indian ships are built? Is it a fact that it is never attacked by sea worms (teredo, Lin.)?

8. The various kinds of pulse, as pease, beans, phaseoli, &c. especially such as are reared at the Cape of Good Hope, and exported to the Indies; the other fruits likewise which are cultivated at the Cape, and taken in as refreshments on board the European ships.

9. The different kinds of palm trees, their nature, soil, characters, names given by the natives, and the uses they put them to, or their fruits, leaves, bark, pulp, &c.

10. To what genus and species does the grass called Tatak belong? and where does it grow, besides Madagascar, Java, the Malay Islands, and the French Ile de Bourbon? The grasses in general which thrive in particular countries and climates, with the soil and culture, and the kinds of cattle most addicted to each.

11. What plant bears the famous Indian nut, which is used as a restorative, and is immensely dear, being sold according to some at three thousand pounds each; the place where it is cultivated, the soil it requires, and its real or imaginary virtues?

12. The Columbo root, called by the Portuguese Raiz de Mozambique, is a native of the continent of Asia, but it has been transplanted to Columbo in Ceylon, and the Dutch now supply all Asia with it. Is it different from the root of Lopez or

Lopezia; and if so, what are the characters of each?

13. A description of the small grains and phaseoli, with which the Indians on the Coromandel coast sow their fields after the rice harvest, with the minutiae of their cultivation, especially the machines employed for watering the grounds.

14. A tree or plant in Cochlin China, called Tsai, on being fermented like Indigo, plentifully furnishes a green-coloured flour, which in dying gives a lasting tincture of a fine emerald; it would be therefore worth inquiring after the method of extracting the colour, and the additional substances employed in fixing it, and what stuffs are best fitted to receive the same.

15. Are the stamina of the pterocarpus draco, Lin. which is called Draco arbor filiquosa populi folio, by Commelin, and Lingoum by Rumph. Amb. 2. t. 70. connected or separate?

16. Which genus of plants does the true ebony belong to? Is it an aspalathus?

17. Many varieties of rice are found in India, as the red, with red husks; the little rice, small grained, oblong and transparent; the great long rice, with round grains; the dry rice, which grows best on a dry soil, and requires no watering; and the common rice; are these various kinds of rice different species or varieties only? The culture, characters, and specimens of each, if different, would be necessary.

18. There is an elastic gum, called Borrachio in Portuguese, and Kaoutchuck in the language of the natives near Cayenne in South America, of which

which it is said the Chinese make rings for lascivious purposes, but here used by surgeons for injecting liquids, and by painters for rubbing out black-lead-pencil marks. Is this gum manufactured in India or China, and from what plant, and in what manner, with the different uses it may be applied to? Is the plant an Euphorbia or Apocynum?

19. What plants produce gum myrrh and gum ammoniac, and how are they collected?

20. What plant affords the gummi rubrum astringens from Gambia?

SECT. VI.

Mineralogy.

And join both profit and delight in one*.

GREEK.

1. **T**HE manner of working mines, and the methods employed in getting, breaking, and extracting the ores; the tools and machines employed for each of these purposes, are subjects worthy of inquiry. Is gunpowder ever used to blast the stones or ores? The manner in which the ore or metal is found under ground, whether in perpendicular veins, or in vicinity to them; in horizontal flat strata, loose pieces, or in solid continued bodies; in what kind of stone, and at what depth; the means of carrying off the water when present in the mines. The vapours found in them, whether mephitic and noxious, or inflammable when fire or light comes in contact with them.

2. The manner in which white copper, resembling silver, is manufactured, and the various processes whereby it is done.

3. The operations used in extracting the metals from the respective ores, with specimens and names of the ores, and the places where they are

* Simul et jucunda et idonea dicere vitæ.

HOR.

procured;

procured; the products yielded from the ores by fusion; the fluxes added to promote fusion, or the substances to prevent volatilization, and whatever is subservient towards refining of metals or reguluses; with the structures and materials of the ovens, the fuel and quantities of it employed, the time for each operation, and the preparatory cautions, including the picking, pounding, washing, sifting, and ustulating of the ores; and drawings of the various machines and tools used for each purpose.

4. The places from whence the various gems or precious stones are procured, with their prices on the spot; the ground and strata wherein they are found, and the figure or form of each kind before being cut, whether determinate and general, or accidental.

5. The manner of manufacturing those immense quantities of saltpetre annually exported from the East Indies; the soil employed for the lixivium, and the manner of preparing the soil. Are any animal or inflammable substances added to it? By what means is lixivium precipitated? Is an alkali used for that purpose, and how is the alkali procured? Is any use made of the remainder of the lixivium after the precipitation of the saltpetre? Is the lixivium boiled, and inspissated by fire for the crystallization, or by the heat of the sun?

6. If borax be artificial, in what manner and from what substances is it made? If native, in what strata and soil does it lie?

7. How far has the knowledge, value, and use of metals extended amongst nations?

SECT.

SECT. VII.

*Directions for taking off Impressions or Casts from Medals and Coins.**Ex catena pend gemelli.*

HORAT. Ep. X.

CHIEFLY owing to the cost required for purchasing a cabinet of medals; it has happened that the study of them has hitherto been confined, comparatively, to a few individuals. Another principal impediment to the cultivation of an acquaintance with them, has arisen from the difficulty of understanding the inscriptions, for want of a sufficient knowledge of languages; on which account, in particular, this study has been condemned by the illiterate as barren and useless; but such as are acquainted with the advantages which have already resulted from those *nummi memoriales*, cannot hesitate a moment to assist in promoting a more general pursuit of the subject*.

While Colossian statues, and the hardest marbles, with their deepest inscriptions, are destroyed by accidents, or by time, and paintings finished with the highest colours quickly fade, a medal shall survive innumerable accidents, and disclose historical facts a thousand years after statues are

* Though the study of medals does not properly belong to natural history, this short account of taking impressions from them, may prove acceptable to some travellers.

crumbled

crumbled away; and when nothing but the names of an Apelles or a Praxiteles remain. Does not a single medal, of which we are in possession, give us greater light into history, than the once famous libraries of Alexandria and Pergamos, which are now no more? From these, and many other considerations, I would willingly contribute my endeavours to render this study more general, and consequently more useful. I have tried a variety of methods to enable a young medallist to collect a cabinet, which may initiate him into the knowledge of medals and coins at a trifling expence.

The method of taking off plaster of Paris and sulphur impressions, is known to every body: the first is too soft to preserve them from injury, and the brittleness of sulphur is a greater objection.

By forming a coat or layer of thin metal over the plaster of Paris, it would be a considerable defence. Tin is the cheapest and most convenient metal for the purpose, as it is sufficiently flexible, and at the same time very much resembles silver. The tin-foil should be of the same kind with that used for silvering looking-glasses. It should be laid over the medal or coin intended to be taken off, and then rubbed either with a brush, the point of a skewer, or a pin, till it has received perfectly the impression of the medal; the tin-foil should now be pared off round the edge of the medal, till it is brought to the same circumference: the medal must then be reversed, and the tin-foil will drop off into a chip-box or mold ready to receive it, the concave side of the foil, or that which is laid on the face of the medal,

D d

being

being uppermost; upon this pour plaster of Paris made in the usual manner, and when dry, the figure may be taken out of the box or mold, with the tin-foil sticking on the plaster, the convex-side being now uppermost again, in which position it is to be kept in the cabinet, after it becomes dry. To have an impression very perfect, the thinnest tin-foil should be made use of*.

The impressions taken in the foregoing manner almost equal silver medals in beauty, and are very durable: if the box or mold† be rather larger than the impression of tin-foil, the plaster, when poured on, runs round it's edges, and forms a kind of white frame, or circular border, round the foil, whence the new-made medal appears the more neat and beautiful. If this tin-foil be gilt with gold-leaf, by means of thin isinglass glue, or boiled linseed oil, the medal will resemble gold.

* This method does not in the least injure any medal or coin.

† Chip boxes, used by apothecaries, answer this purpose, and may be easily procured. A slip of paper wrapped round any circular body with a flat surface, is equally convenient.

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